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NIGHT MERCHANDISE TRAINS OUTBOUND FROM CHICAGO, ILL. (SEE ARTICLE, PAGE 49)

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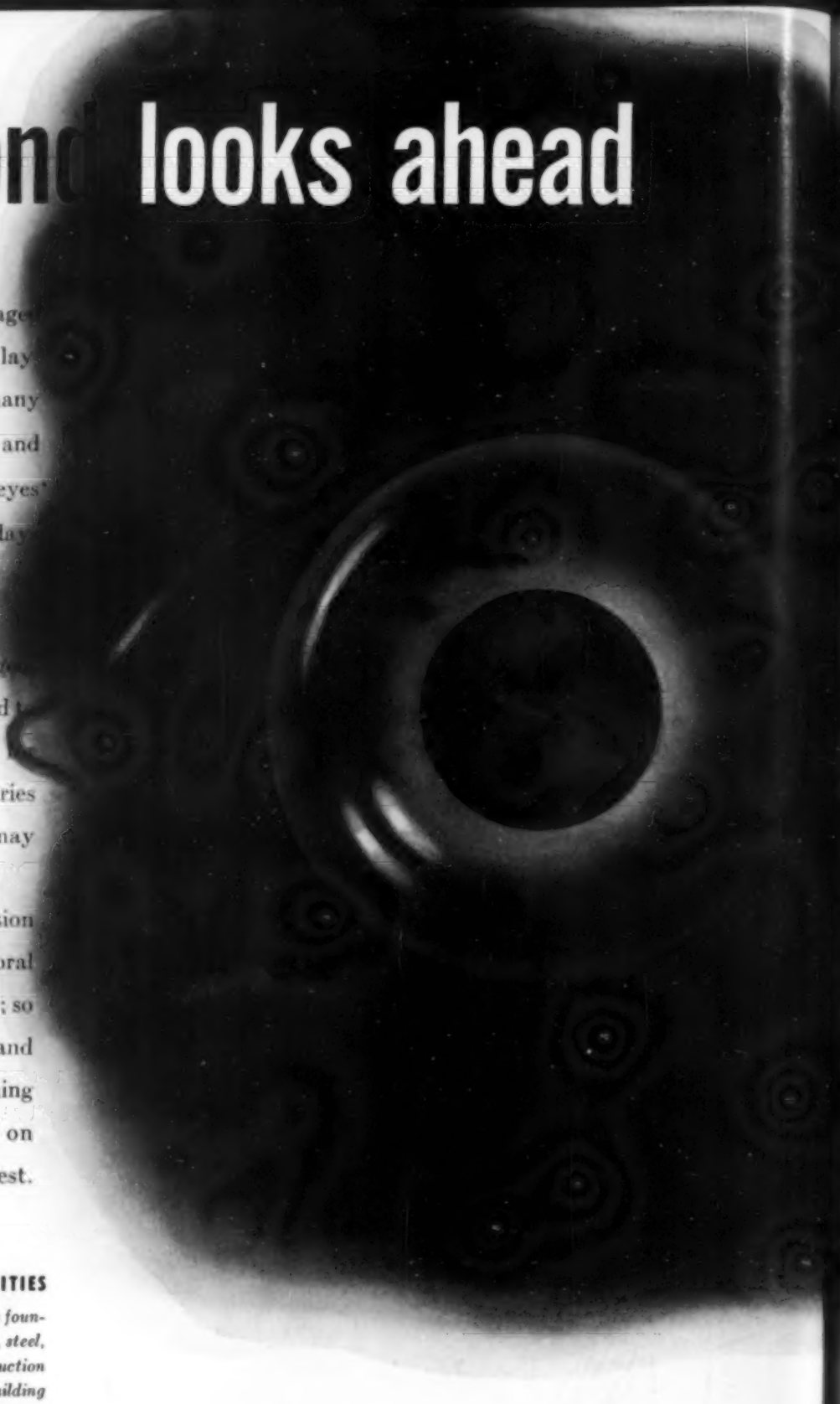
Raymond looks ahead



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Postwar Transportation Problems

Aspects of the National Situation Reviewed and Forecast in a Symposium Condensed from Papers Presented at the Fall Meeting of the Georgia Section at Atlanta, Ga.

Coordination of Agencies

By CHARLES B. BREED, M. AM. SOC. C.E.
PROFESSOR OF CIVIL ENGINEERING, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASS.

THIS symposium includes three other papers on postwar transportation—one relates to railroad, another to highway, the third to air transport. Water transportation does not form a part of the symposium because of lack of time.

For years the trend in public thought has been toward a logical coordination of all transportation agencies. But progress toward such coordination has not been very satisfactory. Private interest often has not been compatible with it. Each agency is prone to hold all the traffic it can, even though another agency could transport it at less cost. To judge the merits of coordination and the specific sphere to which each agency economically belongs, one must examine the basic facts and appraise them in correct perspective. Some of the facts are physical and therefore readily understood by the engineer; others are public attitudes as expressed in legislation and the psychology of travel, both of which are not readily predictable.

Consequently, when we endeavor to place each form of transportation in its proper economic field, we find ourselves unable to do it in an academic fashion, as an economist or engineer would, because the will of the public as expressed in legislation alters the whole economic picture, and in fact may change it next year from what it is this year. About all we can do right now is to view the situation as though the public aids to highway and air traffic will be in a very general way the same after the war as they were just prior to it.

Since transportation affects the lives of everyone, this problem has universal significance. In fact, this present conflict involves effective transportation every moment of the day and night. The war's impact on transportation has been so great and insistent that engineering ingenuity of the highest order has been taxed to the utmost. All this intensive study and application of American ingenuity to the war transportation problem is teaching us two things—its faults and its greater possibilities.

We have been forced by the competition of war to attain a dependable and greatly expanded transportation. This has been done by the railroads by increasing operating efficiency using the old plant, with very few additions. It has been done on the highways through more effective use of trucks and buses even with enforced curtailment of mileage. It is being done in the air through the addition of thousands of planes of more effective performance used exclusively for war purposes; and in civil aviation it has been accomplished by a more intensive use of available aircraft. The civil airlines never had more than about 350 planes, and in 1942 over a third of these were transferred to the Army.

The war has added little to railroad equipment, either civil or military; it has added tens of thousands of trucks and motor cars for military purposes, some of which may later be turned over for civilian use; it has added tens of thousands of airplanes and hundreds of improved and new airports, later to be available for civil use.

After the war, it is obvious that we are going to have all the airplanes we can possibly absorb in civil transport. These war planes, however, have been designed for speed, maneuverability, and other qualities which are not necessary or economical in the commercial field. But it is clear that any one of the plants now building airplanes could fill all the needs of commercial air transport in a very short time—and new designs adapted to economical commercial transport are in blueprint form at this moment.

In this symposium we are to study the transport problem of, say, the next ten or fifteen years. If the probable future of each transportation agency is to be envisioned, it can only be done by careful analysis based upon facts. Our study then is a research in which we must first set up our problem, next identify the facts required, obtain and evaluate those facts, then apply logical analysis to reach a conclusion. Our problem is: After the war which transportation fields should be held by the railroads, which by the highways, and which by the airways?

Obviously, each should serve the field for which it is economically fitted and in which it can offer superior service. This implies a knowledge of the cost of operation for each type of service. Such costs are largely a matter of record on the railroads; they are known within small limitations for highway transport; and, while they are fairly well known for the airplanes of the past, they are more problematical for those expected to come into use directly after the war. We are doing more guessing in

A TERMINAL OR JUNCTION THAT CONNECTS THE CONSUMER WITH BOTH RAIL AND HIGHWAY TRANSPORTATION FACILITIES—CHICAGO'S MERCHANDISE MART

Left: Rail Facilities Lead Directly to Heavy-Duty Elevators; Right: Off-Street Loading Platform Served by Freight Elevators Accommodates 80 Trucks

economics in the field of air transport than in the case of the other two agencies.

After all these facts have been analyzed, the conclusions reached as to the economic field of each agency are all radically altered by the acts of legislatures in subsidizing one and not another form of transportation. Up to now the federal government's attitude toward railroads has been restrictive; toward highway transport, protective; and toward air transport, promotional.

The public's specifications for transportation are low cost, dependable and frequent service, and safety. The transportation of persons and goods starts at one door and ends at another. The public would like to have the whole job done in one operation. Only one agency can do this at the present time, and that is the motor vehicle. It can call at your door and arrive at the door of your destination. Thus, the trucker who picks up the load at the consignor's door often transports it over a much greater distance than is economically sound, simply because the trucker possesses the load and he does not intend to pass it over to the railroad or to the airplane for the long haul, to which agencies it economically belongs. The trucker is able to travel long distances by highway because about half the cost of the highways over which he travels is paid for by the public through general taxation, and most of the other half by the 25,000,000 passenger car owners.

On the other hand, the railroad does not reach from the consignor's door to the consignee's door except in the rare case where each has a private siding. Usually the railroad traffic, passengers or goods, requires transportation at each end of the trip by some other means such as the automobile, street car, bus, or truck. The airplane, likewise, does not reach the consignor's or the consignee's door. Its terminals are airports, several miles from business or residential centers. All persons and goods must take a motor trip at each end of the journey.

Railroads and airplanes belong economically in the long-haul business. Therefore they will always compete for the same traffic. Air has time to sell; the railroads have dependability, low cost, and comfort. Railways and highways are in the short-haul business, but since the motor vehicle can go directly from door to door without a transfer of load, it has a great advantage over the railroad in this field. Railways hold the advantage in the mass transportation of persons even on short hauls.

All three agencies require (1) terminals, (2) ways over which to operate vehicles, and (3) the vehicles themselves. The railroad has to provide all three—terminals for its passenger and freight trains, its roadway and signaling system, and its rolling stock.

While commercial highway transport provides terminals, a vast amount of traffic is from door to door and therefore requires no terminals. Highway transport does not pay its full share of the cost of highways and signaling. It does provide its own rolling stock.

Air transport pays very little for the terminals (airports), and nothing for the airways or aids to navigation along the airways and at the airports. It provides only the airplanes. The tendency now is to charge a small landing fee for commercial planes at airports. Particularly through the public's provision of airports, airways, and mail subsidies, air transport has been materially subsidized. To what extent the public will continue this policy will have much to do with the competitive relation between air and land transportation.

Government policy has been against coordination of the several forms of transportation by means of mutual ownership or control. The attitude of the Interstate Commerce Commission has been to restrict the ownership of truck lines by the railroads. The Civil Aeronautics Act of 1938 prohibits surface carriers from entering the field of air transportation. The Lea bill, which is now under discussion in Congress, retains this feature of the Civil Aeronautics Act. These restrictions prevent coordination through the formation of large transportation companies equipped to furnish any means of transportation that may be desired. The only alternative for coordination is through cooperation and mutual agreement. Such coordination will be difficult to attain in the face of the keen competition for the same traffic which will develop among the several forms of trnsportation after the war.

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SANDBLASTER IN A "DIVER" HELMET, HIS LUNGS PROTECTED BY CHARCOAL FILTER, REMOVES RUST FROM AN OLD CAR

Southern Ry.

A DIESEL-POWERED MERCHANDISE FREIGHT TRAIN OF THE SOUTHERN RAILWAY

American Railroads Are Preparing

By ROBERT S. HENRY

ASSISTANT TO THE PRESIDENT, ASSOCIATION OF AMERICAN RAILROADS, WASHINGTON, D.C.

IT cannot be repeated too often that there is no one best form of transportation, no single type that can do the whole job. Some things can be done better by a train than by a truck; some, better by a truck, or a plane, or a boat than by a train. Still others can be done better by a man with a wheelbarrow or a boy with a bicycle.

In the future even more than in the past, we must see that there is no artificial and arbitrary diversion of transportation jobs from that agency which can best do them, to some other which cannot do them nearly so well. Instead, if we are to get the best out of our transportation plant, we should let the shipper and the traveler make their own choices on the basis of the service they desire, and the cost they care to pay, with equality of treatment among the various forms of transportation.

With that preliminary, I am going to try to visualize the railroad, the physical thing itself, of the future. There will be no revolution in railroading after the war. There never has been. Railroading has been a process of evolution from the beginning, further back than most people realize.

Actually there were railroads of a sort in Queen Elizabeth's day. It is true the power was furnished by horses, the vehicles were wagons; but they traveled on rails which smoothed the way and eased the load. Ever since we have been moving forward—sometimes faster, sometimes more slowly—always moving, consciously or unconsciously, toward the goal of the best possible machine for the mass movement of persons and freight. The machine we have created is magnificently efficient, given a sufficient volume of freight and passengers to move, and by the same token magnificently wasteful where there is only a little shirt-tail full of business to be done. Events of these war years have proved once more, if further proof were needed, that the real key to successful railroad operation is volume.

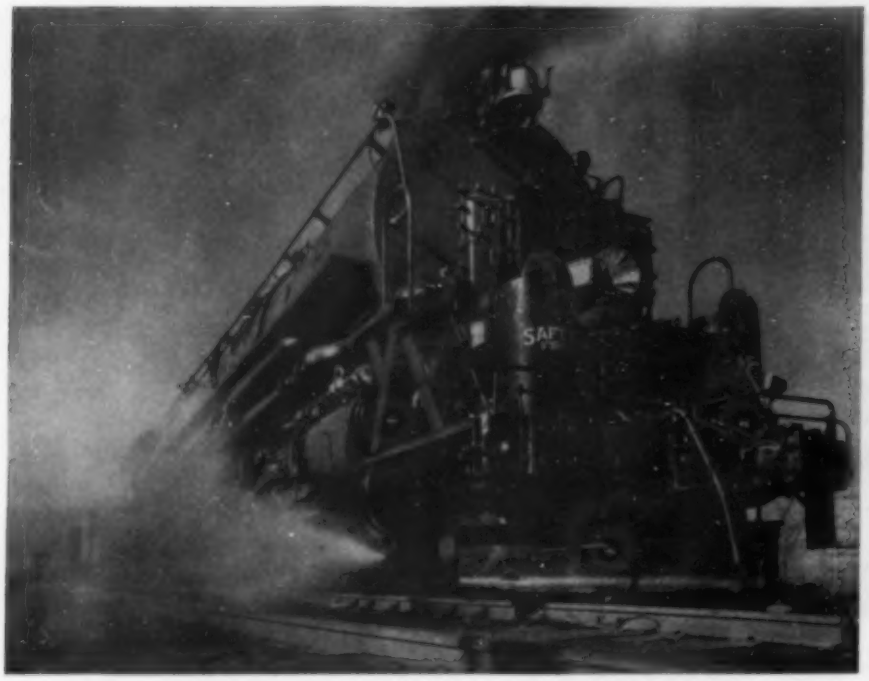
As for facilities, the fundamental feature of railroading is the least dramatic part—the track. Most people think of railroads in terms of locomotives and cars; and they are essential. But all these depend on the track as the fundamental part of a railroad. It will remain so for a good reason, an inescapable reason—a sound physical engineering reason—that on no other surface known to man, or within the range of his imagination, is it possible to do the things that are done every day on railroad track. Only on the surface of parallel raised steel rails, on which the flanged wheels of cars will cause whole trains to track behind a unit of power at good speed, is it possible to move freight and passengers in such volume at such speeds.

Load times speed equals transportation output. In the last twenty years we have considerably more than doubled the transportation output per train hour. That same tendency will continue.

Tracks will be better than now. Advances in the metallurgy of steel will surpass the great improvements of the past twelve or fifteen years in the steel rail. Track joints will be less numerous and will be stronger. We shall learn more about how to keep rails from breaking under traffic.

As to cross ties, when we can take an ordinary piece of soft wood and impregnate it with chemicals under pressure so that it will last in the track, properly protected, for twenty-five or thirty years, that is doing very well. We shall have better grades and better curves—not so much to increase the speed of movement (although that will be done and that is important in passenger service) as to increase the load that can be drawn behind an engine.

On these better tracks we shall operate better cars, made to an increasing extent of the lighter-weight alloy metals. This will not be, as is commonly thought, so



Western Maryland Ry.

A FAST WAR TRAIN NEARS THE EASTERN SEABOARD

much to increase the speed, because after all the speed of freight trains between terminals is not tremendously important—it is keeping cars rolling that is important. The use of lighter materials is to increase the pay load, the proportion of the gross weight that returns revenue. On these cars, we shall have better draft gear, and better brakes. Modern railroading, mass transport by rail, really dates from the time when we learned to handle freight trains with air brakes—some fifty or sixty years ago.

These trains will be pulled by better power. We see the beginnings of the diesel evolution now. After the war there will be further progress in the steam locomotive. There will be additional central station electrifications where the conditions, either of tremendous traffic or operating difficulties, call for it. But we shall see, I think, a more extensive development in the individual power unit, the locomotive that carries its power plant on its own back. This will be in both steam locomotives and diesel, and, perhaps turbines, either steam or gas. Perhaps we may even blow up an atom in a cylinder some way. That is a little bit fanciful as yet, but these other things are not fanciful—they are in the minds of men; some of them are on the drafting boards; some of them are in the experimental stage.

The very events of war which have brought about so tremendous a technological development in some of the other forms of transportation have in a sense checked and frozen the evolution of design on railroads. We are not building such good locomotives now—the few that we are building—as we rebuilt before the war, because we cannot get the nickel steel, for example, to put in the boiler shells or the alloys for motion work. Our few new freight cars are not so good because of lack of copper bearing steel and other critical materials. We have had to redesign backward to secure what little new equipment we have with the materials that are available.

Because of the war, and the railroad's part in it, it has not been possible to build new equipment or to carry forward great changes in design. Yet those things are in the minds of men, and they will be done. They will be started as promptly as possible after the war.

Most persons think of railroads in terms of the passenger side of the business, although as compared to freight this is relatively less important both to the railroads and to the community. Just before hostilities began, the Pullman Company had completed cars of two new designs. One was a roomette car, with twenty-four little cubicles, each a complete living unit for one person. By fitting twenty-four into one car, they are able to sell the service at a charge very little if any more than that for an ordinary lower berth. The other was an experiment in the opposite direction, a sleeping car three tiers high, containing forty-two berths in all, for still lower rates. Sample cars of both types were put in service just before hostilities began. As a result of their use and the suggestions received I am told that 105 further improvements in design have already been put on the drawing boards and are ready to be put into physical existence just as soon as we can get back to the building of passenger cars.

Terminals are tremendously important in all forms of transportation, and especially in rail transportation. We shall see great development of terminals, but nothing revolutionary. There will be a greater use of gravity yards, especially of the retarder type, in which one man sitting in a tower can control the movement of the cars coasting down the hump, not only turning them into the classification track where they should go, but bringing them to a stop where desired.

There will be great improvements in the intracommunication systems of yards—in the facilities for two-way conversations between the men on the locomotives and the men in the office. We shall see improved handling of trains out on the line, too, through perfected communications and such means as centralized traffic control, which has come into such wide use in the last few years. Incidentally, this in time to come will enable the railroads to avoid the heavy expense of much additional multiple track.

One fact about the future as well as the past is that everything introduced on a railroad must work with what is already there. It is not only a financial impossibility, but a physical impossibility to wipe the slate clean and start all over again. A shining example is the automatic safety coupler. There was never any trick about inventing it—3,000 patents were taken out on the subject before 1890, and of these 42 were considered good enough to be tested by the old Master Car Builders Association, now a part of the Association of American Railroads. Actually the problem was to find one that would work not only with others of its kind, but also with the old hand-operated couplers already in use. Obviously, it was not possible to close down the railroads for a week or a month or five years to rebuild all the freight cars in the United States.

The new coupler had to work right along with every car that was already in use. This problem was solved fifty-odd years ago, so that now any one of the nearly two million freight cars on this continent can be made to grab hold of any other one by either end wherever they meet and can be made to uncouple, too, automatically, when it is desired to do so.

Our real problem, our difficult problem in the railroad business is going to be on the economic side, to make the most effective use of the improvements that are in the minds of men as well as in actual existence. That is going to involve rate policies. Railroad rates are, and will be made, to produce volume. They always have, in spite of some opinion to the contrary. The most expensive thing that a railroad can haul is the air in an empty car, so every railroad traffic manager tries to find the rates that will produce traffic and get it on his railroad.

By and large, this has been done well. There has been tremendous development of traffic at rates which, all things considered, are so much lower than those of any other form of general commercial transportation that there is no real comparison. This does not mean that every railroad rate is lower than every rate by any other form of transport, but that the over-all average charge for hauling freight on railroads is distinctly less than that for any other form of common carrier transportation.

Northern Pacific Ry.

A HEAVY FREIGHT EXTRA IN THE ROCKIES NEAR LIVINGSTON, MONT.

That is important. As much as is heard about the demand for speed in freight service, I can assure you that a little shading of rates will dissipate most of the anxiety for speed. Of course, there are occasions, as for example when some great industry is shut down for lack of small parts in a machine, when time means everything and cost nothing. But in general, the hauling of freight, the business on which the railroad lives and on which this country lives, comes in scheduled movements.

They are not emergencies that come up of a sudden; they are things that were planned months, perhaps years ago. The thing that is sought is not so much speed of movement as dependability—starting the flow and keeping it going—and economy.

On the passenger side, I know railroads cannot compete with airplanes in the matter of speed over any considerable distance. We have some things to offer though—spaciousness, the chance to get up and walk around, go from one end of the train to the other; comfort, and even luxury.

These are the railroads' cards in this great transportation game we are all going to play after the war: capacity, economy, and dependability on the freight side; spaciousness, comfort, smartness, on the passenger side. All signs point to the fact that there is going to be intense competition, more than anybody has ever seen before. But I believe that the railroads will be in there doing their share.

Air Transport Looks Forward

By CHARLES I. STANTON

ADMINISTRATOR OF CIVIL AERONAUTICS, DEPARTMENT OF COMMERCE, WASHINGTON, D.C.

SHORTLY before the present World War, competition in the transportation business became three-dimensional. After 1935 air transport began to make substantial inroads on certain classes of railroad business. The postwar period will see a further increase and the competition will be proportionately keener.

Much discussion on the postwar prospect revolves around the question of whether the relationship between the airlines and the railroads will be one of mutual aid or active competition. In my opinion the relationship will be mixed. The services of one will supplement the services of the other. There is no use dodging the fact that in many fields of traffic they offer very different types of service, and that a large number of travelers and shippers will have a choice to make on the basis of economy and speed.

Approximately 50% of passenger travel over 100 miles can go either by air or by rail, depending upon whether greater speed or greater economy is desired. About 2% of all transport of goods probably falls into the same category. Choice will be governed by the relative success of the air lines and the railroads in improving existing services, reducing costs, and increasing the general convenience of their services.

First, let us glance at the air traffic picture as a whole. Existing rates of fare on the airlines average just over 5 cents per passenger mile. Aircraft of 21-passenger capacity travel at a cruising speed of approximately 180 miles an hour at an altitude of 10,000 ft, or at an average over-all speed between terminals of roughly 155 miles an hour. A traffic survey by the Civil Aeronautics Board revealed that in 1940 the air lines carried about 20% of the passenger traffic of 1,000 miles or more, and 11% of that of 200 miles, as between New York and Washington.

Air express charges, including pick-up and delivery, range upward from 67 cents per ton-mile for heavy shipments over long distances to 83 cents per ton-mile

THERE IS A FUTURE FOR THE PLANE CARRYING TWENTY TO THIRTY PASSENGERS—IT HAS THE REQUIRED FLEXIBILITY

for a 10-lb package carried, say, from Washington to Montreal. These rates are going to come down, but the most optimistic prospect at the moment is about 12 to 15 cents per ton-mile, and that would have to be for large shipments. Postage for air mail is double that charged for an ordinary letter, but air mail now carries about 10% of all non-local letters.

It seems likely that the average cost for air mail will not exceed 0.4 mill per lb-mile, representing a 60% decrease from the 0.96 mill prevailing during the fiscal year 1942. While 0.4 mill is still almost three times as high as the cost for surface mail transport, the difference does not seem large enough to justify restricted use of air transport of mail.

Between 1927 and 1942, the number of passengers riding on U.S. airlines increased from 8,700 to more than 4,000,000 a year. During the same period air mail increased from 1,270,000 to 44,600,000 lb annually; air express and freight, from 46,000 to 22,300,000 lb each year. According to a recent conservative estimate by the Civil Aeronautics Board there will be a five-fold increase in domestic airline operations by 1947, and eightfold in intercontinental and transoceanic air passenger traffic.

When the railroads had finished building their main east-west and north-south lines, they did not stop there. They began to crisscross the country with secondary lines and to double-track their main lines. We are, in my opinion, entering that phase of development in the commercial history of the airplane—a phase requiring expansion along all lines. By expansion is meant adding hundreds of new schedules or stops, adding thousands of miles of new routes, and carrying millions of new passengers. We can meet the challenge presented by the possibilities inherent in air transport only if we take advantage of the opportunities.

There are in the United States 140 metropolitan districts, each containing 50,000 or more people. They constitute our major markets. Yet, on June 30, 1943, 22 of these were not certificated stops on our air transport system. Their only air service was provided by airports serving other cities, usually at some distance. Similar figures for interconnections and smaller communities make it fairly obvious that we shall need many new air transport routes, many new schedules, and many new stops.

Air transport has been used almost exclusively for longer distances. It has been used little if at all for the shorter hauls. The explanation is obvious—surface transport over short distances provides speed and comfort approximating that of air transport and at lower, often very much lower, cost. If air transport is to be properly developed, it must strive to become superior to rival forms of transport over shorter as well as longer distances.

We have made some studies to determine the optimum distance for air travel. In the Northeast, above the Ohio River, it lies somewhere between 150 and 200 miles as measured by rail, probably closer to 200 miles. It is significant that our basis of measurement has to be in terms of surface transport distance. As the distance of air travel increases above the optimum, the number of passengers declines. Many factors affect the rate of decline, and we have been unable to segregate their influence. Roughly, however, our studies indicate that the number of passengers varies inversely as the 3/2 power of the distance. For example, between two cities 1,600 miles apart, the number of airline passengers is only 12.5% of that between similar cities 400 miles apart.

Also, the total number of passenger-miles declines, and in inverse proportion to the square root of the distance. In this example, the number of passenger-miles at 1,600 miles is half the number at 400 miles. Thus, even though the advantages of air travel increase with distance, the volume declines.

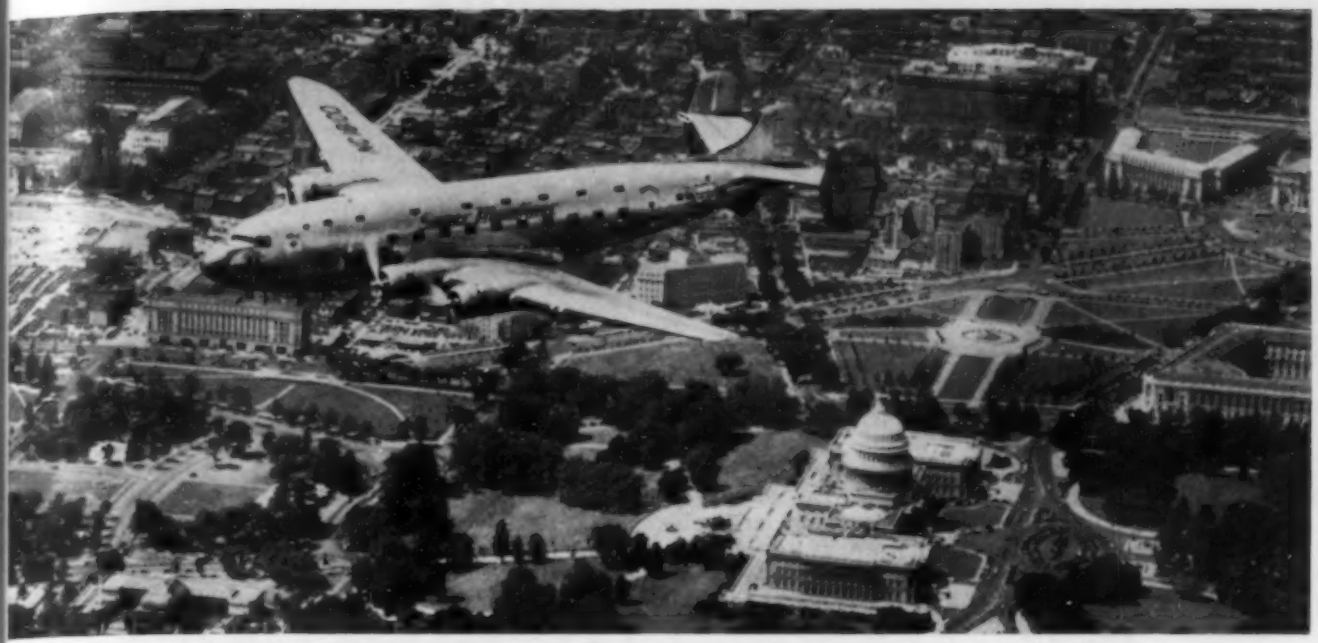
POSSIBILITIES IN SHORTER-DISTANCE TRAVEL

For air transport the significance of these facts is this—the shorter-distance travel market, which is the mass market, has hardly been touched. Assume two terminal cities 600 miles apart by rail, and between them five other cities 100 rail miles apart. Assume further that the terminal cities are of the same size, 100,000, and the intermediate cities one-quarter as large, 25,000, population. In this case traffic will increase rapidly as stops are added. For example, the addition of a stop midway between the terminals will add traffic equal to 50% of the traffic between the terminal cities alone. Extending this known relationship, traffic with stops every 100 miles would be over six times that between the two terminals alone.

United Air Lines

PASSENGERS CAN ENJOY THE SCENERY, PLAY GAMES, TAKE PICTURES OR NAPS WHILE EN ROUTE

With regard to the cost of providing the additional ground facilities, the situation is much more favorable than it seems at first glance. Since total traffic increases faster than the number of stops, passenger-miles per stop go up with each additional stop. On the whole, we can be very optimistic about the ability of the airlines to provide short-distance services at costs comparable to those for longer distances. To operate efficiently



United Air Lines

A FOUR-MOTORED TRANSPORT OVER THE CAPITOL, WASHINGTON, D.C.
Such Large Ships Are Advantageous for the Longer Hops and Transcontinental Flights

at 100-mile stops, a plane should perhaps have the following characteristics:

1. Optimum flying efficiency at low altitude
2. Short range—perhaps 300 miles
3. Short take-off and landing runs
4. Great maneuverability on the ground
5. Low cruising speeds
6. Small size—perhaps with a pay load of as little as 5,000 lb
7. Light-weight, inexpensive, non-de luxe passenger equipment
8. Adaptability to cross-wind landings

One main purpose of specially designing a plane would be to minimize the time lost in making a stop. With prewar equipment, 10 minutes was about the minimum even with no fueling. Perhaps after we have gained experience we can approach the average three-minute stops made by express trains at intermediate stations.

The ideal service for a traveler would be one of door-to-door delivery, so to speak. As a practical matter, this ideal can hardly be approached. Airports are generally some miles from the center of the city, very frequently on the periphery, and there is generally only one air station for each population center. Contrast these with similar features of railroads.

Some pin their hopes on the helicopter to bring air transport services close to the door-to-door ideal. The total lift of any helicopter now in the testing stage is not very large, however. Until a larger craft—something approaching the capacity of conventional transport planes—can be put into service, it does not seem to offer a practical solution to the problem of mass transport over short distances. We do not know, of course, how soon such a large craft may be available. But to judge from the time it has taken other new transport plane designs to be developed and placed in service, it seems to me that a large commercial helicopter will not be ready during the first few postwar years.

To meet some of these limitations, suppose the New York Metropolitan District had six air stations and the Philadelphia District four. This would give 24 possible direct runs—fewer in actual practice. Such a development would go far toward solving the short-distance problem. If it were possible, for example, to increase the number of stations and locate them so that door-to-airport travel time would not be more than 15 minutes, population centers 100 miles apart would be almost within commuting distance, say approximately an hour and a half. Certainly performance of this kind, particularly with high schedule frequency, would attract volume business.

The most important point about the development of efficient short-distance air service is this—it is needed not only for its own sake but also for the fullest possible expansion of long-distance air travel. It is required to furnish the necessary feeder service to trunk lines.

But air transport requires more than planes and pilots to fly passengers, mail, and cargo. To an equal extent, it requires navigation facilities of many kinds and a vast network of airports. The U.S. Federal Airways system now totals 35,000 miles within our continental boundaries, a 700% increase since 1927. Traffic is increasing at an astonishing rate; recorded movements were 6,000,000 during 1942. For August 1943 alone, they were 1,700,000. We expect that they will continue upward despite a probable slight dip immediately after the close of hostilities—that by 1950 we shall have at least a half million private, commercial, and military aircraft in active service. Note that at the end of 1941 we had in the entire country less than 25,000 licensed civil aircraft, and probably less than half that number of military planes.

A SYSTEM DESIGNED FOR MASS TRAFFIC

Fortunately, our airways system, unlike those of Europe, has been designed for mass traffic. It is so closely coordinated with Canada and Alaska that the three virtually form a vast continental system, extending from the Gulf of Mexico to the Bering Sea. We have also installed four intercontinental super-radio stations which in their combined range provide direct communication to planes in flight anywhere on the globe. The major units are located at New York, New Orleans,

San Francisco, and Honolulu, and the supplementary stations at Seattle, Anchorage, and many of the Pacific Islands.

Before the war the Civil Aeronautics Administration made, at the direction of the Congress, a nation-wide survey of airports. We laid out a tentative network of 4,000; evenly distributed they would form a checkerboard of 27-mile squares. If the number were increased to 6,000, the checkerboard squares would be reduced to 22 miles.

At present we have almost 3,000 classified airports—1,000 short of the prewar plan. Recent development has necessarily been concentrated upon the larger fields to facilitate the war aviation activity. As a result, there has been an eleven-fold increase in the number of our major civil airports—those having paved runways at least 3,500 ft long and capable of handling the largest transport craft. Whereas we had only 76 such fields two years ago, we shall have 865 by the end of 1943. Nor does this number include many large airdromes built solely for use by the armed forces. We also have 905 Class II airports, each with paved runways from 2,500 to 3,500 ft long. Assuming that all communities with a population of 1,000 or more will want to be accessible by air, a national total of 6,000 airports is a reasonable target in the early postwar years—roughly twice as many as we now have.

It has long been the federal policy to provide the airways and to assist local and state governmental units in planning and financing the airports. The government may have to extend its activities. Fortunately, the task of financing is not so great as one might suppose, thanks to the efforts over a period of years of local, state, and federal officials, of legislators, and public-spirited citizens. Also, the armed services have installed many airports and other facilities which will probably be available for civilian use after the war.

One of the most striking results of our preliminary engineering survey was to show the relatively small number of stops required to obtain a high population and geographic coverage. Of our 132,000,000 people (1940), 63,000,000 or almost 48%, live in 140 metropolitan areas of 50,000 or more people. Thus, disregarding multiple air stations at the largest places, 140 airports would be enough to serve almost half the population.

To reach about 90% of the urban population, all cities of 10,000 to 50,000 should have direct air service or be within 15 highway miles of an airport. About 460 additional airports would accomplish this. Thus, about 600 airports would serve over 90% of the urban population, plus at least 20% of the rural population—a very high coverage.

Even so, this would leave many smaller places at some distance from an air station. To put every urban community of 2,500 or more within 50 miles of an air station would require about 250 more airports, which would provide very complete geographical coverage. Altogether, these 850 stops would serve an urban and rural population of well over 80,000,000 people, almost two-thirds of the national total.

The cost of improving existing airports and constructing new ones would approximate $215,000,000—based on the use of Class II airports for most of the smaller places. This includes the costs of administration buildings, paved runways, and minimum lighting for night operation. To install additional radio ranges, weather reporting and communication equipment, and airport traffic control towers, would cost an additional $12,000,000. Certainly the total of $227,000,000 is a moderate price to pay for the facilities needed to provide a large and adequate air transport system—which is going to be greatly needed by this country in the first few years following the close of the war.

Advances in Highway Transportation

By GUY KELCEY, M. AM. SOC. C.E.
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IN its earlier stages, our transportation system provided very limited means of local distribution. People and the enterprises they established clustered of necessity closely along main transportation channels and around terminal points. Progressively transportation facilities developed, and the time and cost of local as well as of long-distance travel were reduced while freedom and convenience of movement increased. Important areas, formerly far apart as to time of travel, have become "neighborhoods," separated by a few minutes or hours. The motor vehicle contributed tremendously to the expansion of these transportation facilities, particularly in the field of local distribution.

These developments accommodated an insistent public demand to spread farther out around metropolitan centers thus to take advantage of opportunities in outlying areas, and to enjoy attractive surroundings and greater freedom of action. While the limitations of earlier transportation required close concentration of populations, modern transportation reversed the trend by providing great mobility, range, convenience, and freedom of movement, at a cost within reach. The demand for further postwar development of highway transportation, for short-range air transport, and for other more advantageous local distribution methods indicates continued pressure toward decentralization.

It is particularly appropriate, therefore, to discuss the needs of postwar transportation on highways. We must think of these needs now if we are to perceive with clarity what facilities will be required, and if we are to formulate and pursue a consistent and workable policy in approaching the many questions that will arise.

Between the point of origin and that of destination of traffic many kinds of transportation and numerous facilities may be involved. Each element must be coordinated and balanced as to capacity and efficiency with all other elements, if economical and effective transportation is to be achieved. One or more weak or inadequate elements defeats or limits the effectiveness of the rest no matter how excellent the other component parts may be. There are many such bottlenecks in highway transportation that are extremely costly. These can be and should be avoided. Indeed, the postwar opportunities to eliminate bottleneck elements, to reduce cost, and to increase utility and efficiency are great.

A number of factors merit attention with respect to providing and utilizing facilities for postwar highway transportation. In 1937 the annual cost of all transporta-

A Parking Problem of Defense Industries Graphically Illustrated
View from Above a California Plant

tion approximated 31% of the national income, and the cost of transportation on highways represented 23% of the national income. If, as is believed, these data may be taken as reasonably approximate for other normal years, such high costs constitute a challenge to the officials who build, and control the use of, the highways and to those who depend upon them to provide better and more efficient transportation at lower cost after the war.

The greatest single opportunity to improve highway transportation and to reduce its cost is to be found in congested urban areas. Need for attention to this problem is recognized, and provisions are being made to take advantage of the opportunity. The value of property and of services in all communities is directly dependent on the adequacy of transportation facilities. Undesirable decentralization, declining property values, blighted areas, and other maladies that affect many cities may be traced, in part, to inadequate transportation systems, and particularly to unsolved problems in the adaptation and use of the streets and related facilities.

In many states and large communities there is need for a public transportation official, charged directly with the responsibility of coordinating various agencies and elements in highway transportation to the single end of achieving the greatest public benefits. Some steps that would deserve the active attention of such an official or authority will now be outlined.

Several surveys indicate that at any given time only 1 or 2 vehicles out of every 10 in congested areas are moving to a specific destination. Of the remaining 8 or 9, sometimes as many as one-third are in what might be termed "cruising storage"; the remainder are standing along the streets or in off-street space. The demand for space to accommodate standing vehicles frequently so greatly exceeds the supply that they seriously interfere with the fluid movement of other vehicles.

If ample off-street storage room is provided for standing vehicles, freedom of movement will be restored to other vehicles, many existing roadways can be made to serve, and the need for expensive new roadways will be reduced to a minimum. Off-street facilities for loading and discharging cargoes, and for storing inactive vehicles will bring a large measure of relief in many crowded areas. The proposed federal program to provide such facilities will be a very desirable and less costly substitute for the construction of many new roadways in some urban communities. This program is particularly important because it strikes at the source of the congestion which is doing much to destroy property values and raise the cost of transportation.

In addition to the use of public funds, private capital should be encouraged, in its own interest, to provide off-street access and storage facilities. It should find such investments profitable and self-liquidating, and a means by which the value of property can be preserved and increased.

Prior to and particularly during the present war, staggered hours to level peak loads on transportation systems have demonstrated the substantial benefits to be secured thus in relieving congestion, in speeding up transportation, and in reducing its cost. Retention of many staggered-hour programs already in effect and an expansion of the staggered-hour principle, in terms of postwar conditions, would contribute greatly to improving transportation in many communities, and in relieving other difficulties that impede local development.

In large communities, a majority of the population and the great bulk of the goods must be moved by mass transportation methods to avoid clogging roadways with individual vehicles and to meet community needs for fast, dependable, convenient, and low-cost service. As communities increase in size, the need for mass facilities rises and dependence on privately operated vehicles declines. Proper proportioning of fast and convenient mass transportation must be maintained so that available roadway capacity will be most consistently utilized to meet community requirements.

Rockefeller Center in New York is an excellent example of the benefits to be realized from carefully planned and balanced transportation facilities. The development was made in a three-block blighted area of 12 acres that contained 229 antiquated stores, brownstone-front buildings, and former speak-easies. Construction cost alone was $70,000,000. Life expectancy of the buildings was taken as 40 to 50 years.

The 14 buildings that comprise this development are well separated, have spacious plazas and ground areas to provide light, air, and view. Five million square feet of rentable floor space, or 12.6 times the ground area occupied, is available. Facilities provided for the benefit of 27,000 regular tenants, and an average of 125,000 visitors daily, include a two-mile frontage of shops and services, two theaters, and other accommodations.

Rockefeller Center presents, essentially, a mass transportation problem. Its mass passenger transport needs are adequately met by four subway lines and a number of bus routes. These facilities accommodate huge numbers of people smoothly and without disorder.

Off-street storage of inactive vehicles generated by this development is provided by an 800-car ramp-type garage which occupies six floors—three below and three above ground, in one of the buildings. Short and long-period garage rates offered are as low as, and in some cases lower than, those offered by many other New York midtown garages and are lower than some midtown outdoor parking lots. In making this provision, Rockefeller Center has recognized its obligation to store off the street the idle vehicles it generates or attracts.

Photo by Edward Ratcliffe

UNDER ROCKEFELLER CENTER, NEW YORK (AT LEFT), FACILITIES FOR OFF-STREET PARKING OF 800 CARS ARE PROVIDED, ALSO (AT RIGHT) A SUBTERRANEAN RAMP AND HUGE SHIPPING AND UNLOADING ROOM FOR TRUCKS

Two hundred elevators, some of them capable of high speeds of 16 vertical miles an hour, in 10 miles of elevator shafts, have a capacity of 4,000 persons at one time. In all but two of the buildings, off-street loading facilities are provided underground, from 4:00 a.m. to 7:30 p.m., for some 750 trucks that carry a substantial daily tonnage in and out. Provisions for peak-load, horizontal and vertical transportation were as carefully calculated as provisions for water, waste, electricity, and other services.

It has not been necessary to stagger business or other hours to level peak demands on the vertical and horizontal transport system. There appears to be less congestion and confusion in this neighborhood than during former speak-easy days, and certainly less than prevails in other areas of the same size attracting a fraction of the people or business.

While Rockefeller Center takes the normal peak load in its stride, the situation created when the U.S. Rubber Company moved in, as described in the *New York Times* of March 20, 1940, demonstrates not only its capacity to handle much more, but the value and economy of careful scheduling, dispatching, and handling of highway transportation under pressure conditions. Four hundred truck-loads were moved 12 blocks horizontally and 20 floors vertically in 40 hours, at the rate of 10 truckloads an hour, or one every six minutes. Schedules allowed three minutes to load a truck, three to make the half-mile trip, and three to unload. The elevator movement and distribution of each load was similarly coordinated. The movement was scheduled over a weekend for reasons of economical handling and to avoid interference with other activities in the area.

Some of the benefits that have resulted from careful integration and management of facilities to meet the transportation demands of the Center are worth recording. The investment necessary has yielded splendid returns to its owners, to its patrons, and to the community. While the development was undertaken in a period of severe depression, when the supply of building space available elsewhere in the area greatly exceeded the demand, it has steadily increased its rental area and percentage of occupancy from 3,111,000 sq ft in January 1935 (of which 76.5% was then rented), to over 5,000,000 (of which more than 99% was rented as of October 1943).

In 1929 this area yielded $461,000 in taxes. This return was multiplied over six times, to $2,820,600 in the tax year of 1943–1944. Nine-tenths of the land occupied is rented from Columbia University, which before the development received $300,000 a year. The University now gets $3,300,000 a year rental.

The foregoing facts permit a number of assumptions and conclusions. It seems reasonable to suppose that the same careful provision and planning for horizontal and vertical transportation that profits Mr. Rockefeller and a population of persons as great as that of Salt Lake City, all housed on 12 acres of land, would likewise benefit other property owners, and their tenants and visitors elsewhere. Other projects would gain from the same attention to mass transportation, off-street loading, vehicle storage, and elevator capacity. There is much to be said, too, for the planning of trucking operations as carefully as those of the U.S. Rubber Company previously described.

The Rockefeller development reversed a decentralization trend in a blighted area. While Manhattan, Pittsburgh, and many other communities were losing values, and while the impression prevailed that this was natural and inevitable, a very large group of persons were better accommodated in a smaller space than ever before, and substantial new values were created. New York collects over five times as much taxes as before and Columbia University gets ten times as much rental.

These and other steps will solve many of the problems of congested areas. Obviously they are not the answer to all the ills that beset transportation in crowded communities. Nor do they constitute a permanent solution of the problems of highway transportation. But they are obviously important steps that must be incorporated in present and future transportation programs, if these programs are to meet the demands of the public successfully. The urban aspects of highway transportation in the postwar period are obviously important and heretofore have escaped sufficient attention.

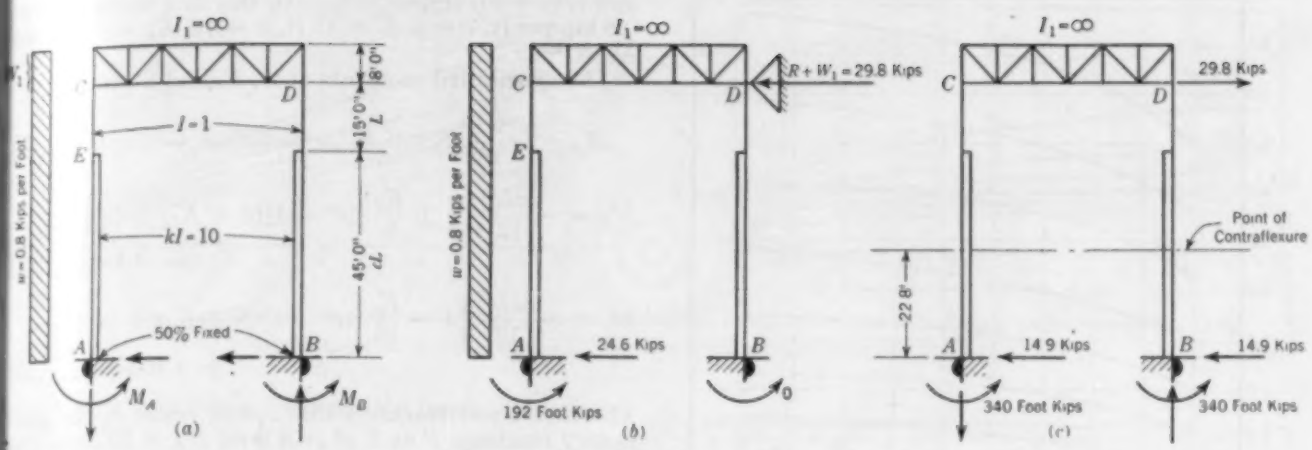

FIG. 1. TYPICAL BENT WITH STEPPED CRANE COLUMNS
Stresses Determined for Wind Loading

Stepped Crane Columns Analyzed by Diagram

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TO design continuous steel mill-building frames, including stepped crane columns, with a minimum of labor and time, it has been found advantageous to make use of diagrams. Preparation of such diagrams (Figs. 4–8) followed analysis of more than 140 bents, by the moment distribution method. It was found expedient to derive general equations for the distributed moments in order to avoid repeating the moment distribution process for each frame. These equations were derived by moment distribution carried for three cycles. The method of analysis can best be illustrated by examples.

COLUMN BASES ASSUMED FIFTY PER CENT FIXED

In order to approach actual conditions, column bases were arbitrarily assumed as 50% fixed (Fig. 1). This was done because column bases very seldom act as completely fixed, nor are they very often completely hinged. Therefore the mean between these two extremes was assumed. It is further assumed that in the deflected structure the upper part of the column will remain vertical, and that for all practical purposes the column can be considered as completely fixed at the bottom chord. The conditions in the bent shown in Fig. 1 (*a*) are a summation of those in the bent in Fig. 1 (*b*), where sidesway is prevented by a force at *D*, plus those in the bent of Fig. 1 (*c*), where sidesway is allowed under the action of the force at *D*. In Fig. 1 (*b*), stresses in the windward

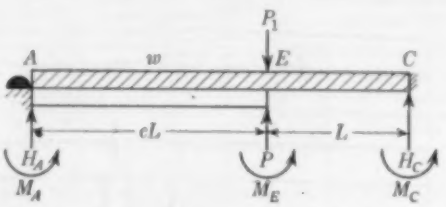

FIG. 2. BEAM SUBSTITUTED FOR COLUMN IN FIG. 1 (*a*) FOR ANALYSIS OF STRESSES

column are analyzed as though the column were a beam fixed at *C*, 50% fixed at *A*, and with a temporary support at *E*. Such a system is shown in Fig. 2. The temporary support is represented by the force *P*. In the calculations that are carried out, *c* is the ratio of height of the lower step to that of the upper step, and *k* is the ratio of the respective moments of inertia. The distribution factors K_1 and K_2 vary with the respective I/L values, and in the notation used, are equal to $k/(k+c)$

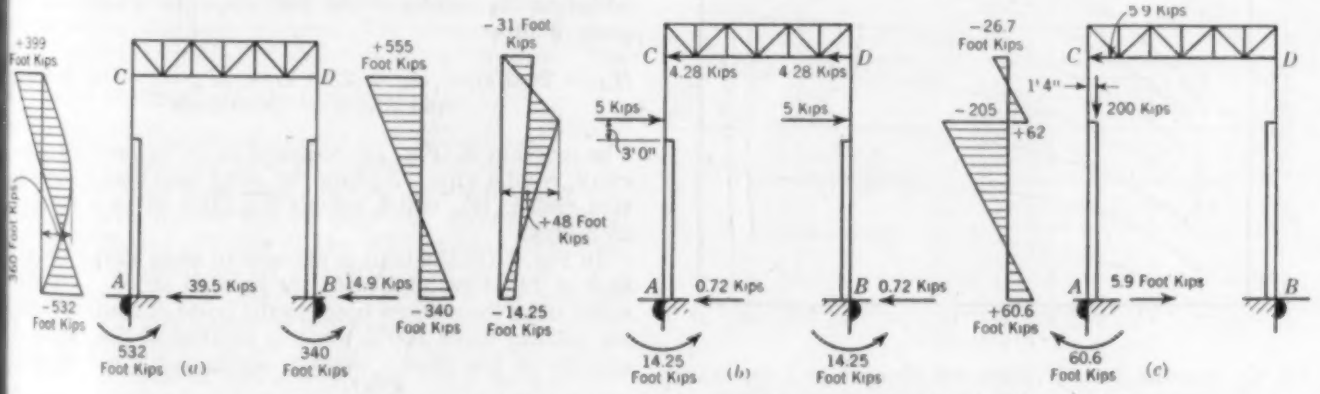

FIG. 3. DISTRIBUTION OF STRESSES IN COLUMNS OF BENT SHOWN IN FIG. 1 (*a*)
(*a*) Stress Due to Wind Load, (*b*) Stresses Due to Crane Thrust, (*c*) Stresses Due to Eccentric Crane Loads

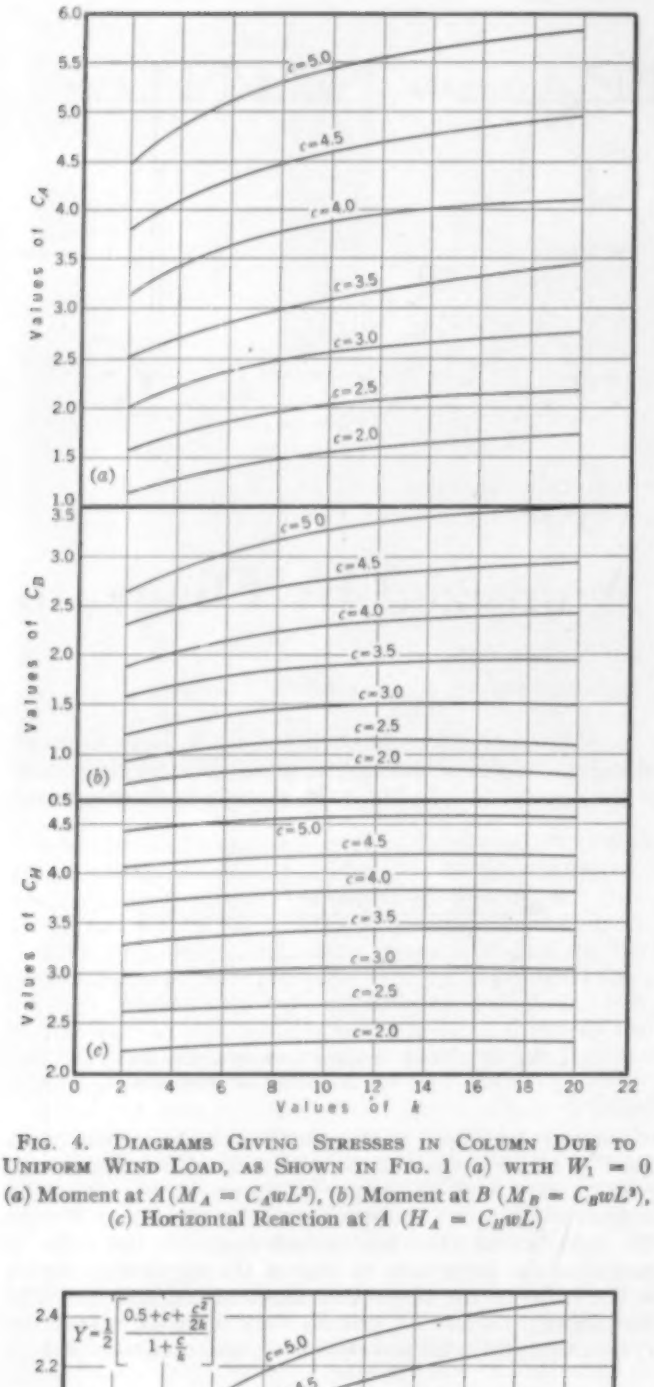

FIG. 4. DIAGRAMS GIVING STRESSES IN COLUMN DUE TO UNIFORM WIND LOAD, AS SHOWN IN FIG. 1 (*a*) WITH $W_1 = 0$ (*a*) Moment at A ($M_A = C_A wL^2$), (*b*) Moment at B ($M_B = C_B wL^2$), (*c*) Horizontal Reaction at A ($H_A = C_H wL$)

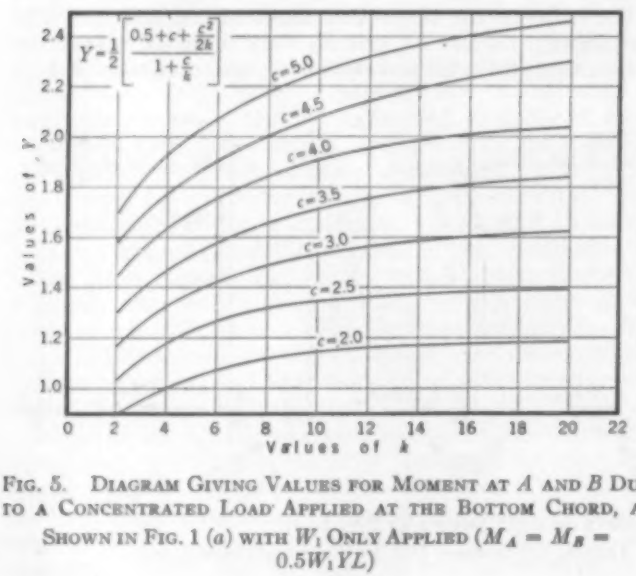

FIG. 5. DIAGRAM GIVING VALUES FOR MOMENT AT A AND B DUE TO A CONCENTRATED LOAD APPLIED AT THE BOTTOM CHORD, AS SHOWN IN FIG. 1 (*a*) WITH W_1 ONLY APPLIED ($M_A = M_B = 0.5 W_1 YL$)

and $c/(c+k)$, respectively. In this first example, $w = 0.8$ kip per ft, $c = 3$, $L = 15$ ft, $k = 10$, $K_1 = {}^{10}/_{13}$, and $K_2 = {}^{3}/_{13}$.

The distributed moments at A, E, and C are:

$$M_A = -\frac{wL^2}{192}[8c^2 + K_1(5c^2 - 4)] = -97 \text{ ft-kips} \quad (1)$$

$$M_E = -\frac{wL^2}{12}\left\{1 + \frac{K_2}{8}[(c^2 - 1)(8 + K_1) + 2c^2]\right\} = -53 \text{ ft-kips} \quad (2)$$

$$M_C = -\frac{wL^2}{12}\left\{1 - \frac{K_2}{16}[(c^2 - 1)(8 + K_1) + 2c^2]\right\} = +4 \text{ ft-kips} \quad (3)$$

The shears and reactions that follow result in the temporary reactions P at E of 26.8 kips, $H_A = 19$ kips, and $H_C = 2.2$ kips.

SIGN CONVENTION EMPLOYED

The sign convention used throughout is as follows: Positive moment produces compression in the top fibers of a beam; negative moment produces tension in the top fibers of a beam. Columns are viewed from the right side of the sheet. In a second step, the temporary reaction P is counteracted by an equal and opposite force. First, on a similar unloaded beam, a trial load P_1 is determined, resulting from an assumed moment at A and E in member AE of 10 ft-kips. The corresponding fixed-end moments at E and C of member EC will be $10c^2/k$ ft-kips, from the relation of moments in two members having the same deflection and different lengths and moments of inertia. The distributed moments at A, E, and C are then, respectively:

$$M_A = \frac{10}{16}\left[8 + K_1\left(\frac{4c^2}{k} - 3\right)\right] = -5.27 \text{ ft-kips} \quad (4)$$

$$M_E = \frac{10c^2}{k} - \frac{10K_2}{8}\left[\left(\frac{c^2}{k} - 1\right)(8 + K_1) + 2\right] = +8.68 \text{ ft-kips} \quad (5)$$

$$M_C = \frac{10c^2}{k} + \frac{10K_2}{16}\left[\left(\frac{c^2}{k} - 1\right)(8 + K_1) + 2\right] = -8.84 \text{ ft-kips} \quad (6)$$

The shears and reactions that follow from these moments result in a trial load P_1 of 1.48 kips. The moments and reactions due to the force P will be directly proportional, and are $H_A = 5.6$ kips, $H_C = 21.2$ kips, $M_A = -95$ ft-kips, and $M_C = -160$ ft-kips. When these are added to the results of the first step, the quantities become finally:

$H_A = 24.6$ kips, $H_C = 23.4$ kips, $M_A = -192$ ft-kips, and $M_C = -156$ ft-kips

The reaction R (Fig. 1*b*) required at D to prevent sidesway, is 23.4 kips. Adding the wind load above the bottom chord, W_1, which equals 6.4 kips, gives a total of 29.8 kips.

In Fig. 1 (*c*) the bent is allowed to sway under the action of 29.8 kips applied at the bottom chord. The distance from the column bases to the point of contraflexure, for column bases 100% fixed, is located at the center of gravity of the elastic weights of the column, the total elastic weight being $\sum \frac{L}{I}$. For column bases 50% fixed, the distance to the point of contraflexure is taken at one-

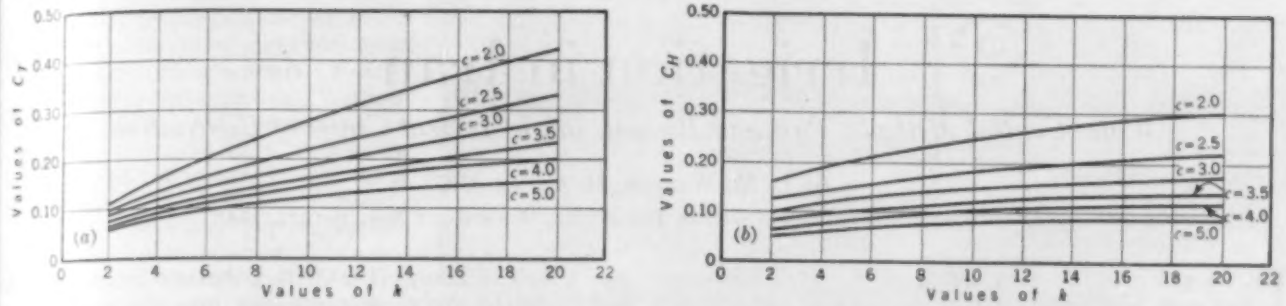

FIG. 6. DIAGRAM GIVING STRESSES IN COLUMN DUE TO A LATERAL THRUST APPLIED TO COLUMN, AS SHOWN IN FIG. 3 (*b*)
(*a*) Moment at A ($M_A = C_T TL$), (*b*) Horizontal Reaction at A ($H_A = C_H T$)

half that for completely fixed column bases, and is equal to $\frac{L}{2}\left[\frac{1/2 + c + (c^2/2k)}{1 + (c/k)}\right]$.

The total moments for the columns in Fig. 1 (*a*) are obtained by adding the moments of Fig. 1 (*b*) to those of Fig. 1 (*c*), as shown in Fig. 3 (*a*).

WIND MOMENTS AND REACTIONS BY DIAGRAMS

Stresses in columns of the same bent, Fig. 1 (*a*), are analyzed by using the diagrams shown in Figs. 4–8. From Fig. 4 (*a*), $M_A = 2.53 \times 0.80 \times 15^2 = 457$ ft-kips. From Fig. 5, $M_A = 3.2 \times 1.53 \times 15 = 73.6$ ft-kips, making a total of 530.6 ft-kips as the moment at A. From Fig. 5, $M_B = 73.6$ ft-kips, and from Fig. 4 (*b*), $M_B = 1.48 \times 0.80 \times 15^2 = 266.4$ ft-kips, making a total of 340 ft-kips as the moment at B. The horizontal reaction (H_A) from Fig. 4 (*c*), is $3.05 \times 0.8 \times 15 = 36.5$ kips, plus $W_1/2$ (3.2 kips), making a total of 39.7 kips. Other moments and reactions are obtained by direct computation.

In Fig. 3 (*b*) the bent is subjected to a crane thrust of 5 kips acting at each column. For this loading condition it will be assumed that sidesway of the bent is prevented by proper diagonal bracing in the plane of the bottom chord. The moment M_A, from Fig. 6 (*a*), for $k = 10$ and $c = 3$, then equals $0.19 \times 5.0 \times 15 = 14.25$ ft-kips. H_A from Fig. 6 (*b*) equals $0.143 \times 5.0 = 0.72$ kips. M_C and H_C are then obtained. Diagonal bracing carries the reaction H_C. For a crane thrust applied at the crane seat, Figs. 7 (*a*) and 7 (*b*) can be used in a manner similar to that shown in Fig. 6(*a*) and 6 (*b*).

ECCENTRIC CRANE LOAD

In Fig. 3 (*c*) the bent is shown with a force of 200 kips acting 1.33 ft from the center of gravity of the column section, causing a moment of 266.7 ft-kips at the crane seat. It is assumed that for this condition sidesway is prevented by diagonal bracing. The moment at C, M_C, from Fig. 8 (*a*) is $-0.1 \times 266.7 = -26.7$ ft-kips. The horizontal reactions, $H_A = H_C$ are equal to $\frac{0.33 \times 266.7}{15}$ = 5.9 kips. Other moments can now be obtained.

For bents with trusses that are very stiff compared to the upper column step, with column bases 50% fixed, the diagrams give results within slide-rule accuracy. For any other degree of fixity of the column base, the bent can readily be analyzed by a similar procedure.

It should be noted that Figs. 4 (*a*) and 5 can be used for bents with any degree of fixity of the column base by using the expression $M_A = FC_A wL^2$, F being a factor of fixity with a value of 2.0 for a column 100% fixed at the base, and varying to zero for hinged columns. In Fig. 5, the expression for moment at the column base becomes $M_A = M_B = 0.5FW_1YL$.

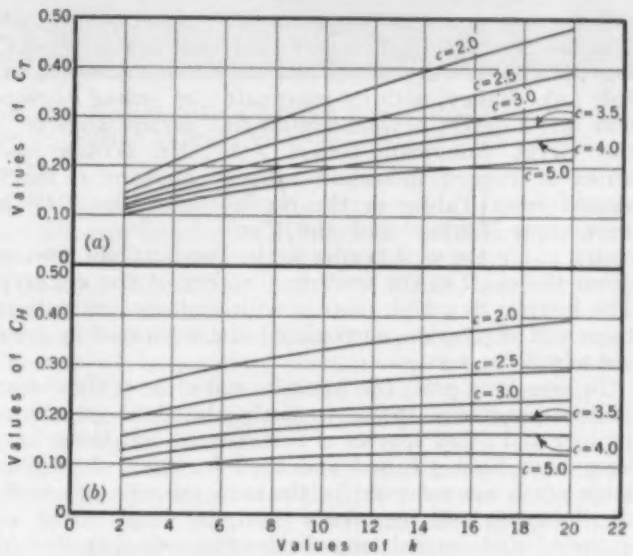

FIG. 7. DIAGRAMS GIVING STRESSES IN COLUMN DUE TO A LATERAL THRUST APPLIED TO THE COLUMN, AS SHOWN IN FIG. 2
(*a*) Moment at A ($M_A = C_T TL$), (*b*) Horizontal Reaction at A ($H_A = C_H T$)

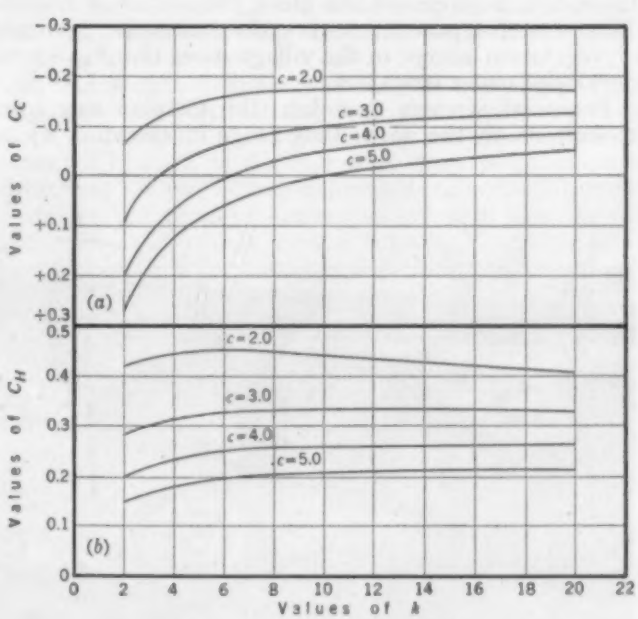

FIG. 8. DIAGRAMS GIVING STRESSES IN COLUMN DUE TO AN ECCENTRIC CRANE LOAD, AS SHOWN IN FIG. 3 (*c*)
(*a*) Moment at C ($M_C = PeC_C$), (*b*) Horizontal Reaction at A and C [$H_A = H_C = (PeC_H)/L$]

Irrigation in Iran

Water Control Methods, Past and Present, in an Ancient Center of Civilization

By L. M. WINSOR, M. AM. SOC. C.E.
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AFTER a year and a half in Iran, on a special assignment to study the problem of irrigation and lay the foundation for rebuilding and expanding the ancient system, Mr. Winsor gave this interesting account of his observations. Slight rainfall, serious deficiency of control works, the unsettled state of the country, and the extreme difficulty of getting appropriations complicate the present problem. Previous reports from Mr. Winsor since he arrived in Iran appeared in the September 1942 (p. 523) and May 1943 (p. 238) issues.

IRAN reminds me very much of our own Southwest and of portions of the western strip of South America. Tehran, the capital, is situated on the south side of a chain of high mountains that separate the rest of the country from the Caspian Sea. The valley surrounding the city is very much like our Salt Lake Valley, with its great salt lake and a desert beyond similar to the Great American Desert. A series of rugged mountain ranges extend from Tabriz in the northwest, near Turkey and the Caucasus, along the west border to the Persian Gulf, then on down the coast to the southeast corner of the country. The interior is a high plateau with scattered mountains barren of vegetation, surrounded and separated by great stretches of desert.

In ages long past, the foothills and some of the mountains supported a sparse to fairly abundant growth of juniper and other species of forest trees, but these have long since been gleaned and used for fuel. Later the large brush was removed for the same purpose. Now the small bushes and the weeds from the desert areas are gathered and carried long distances by donkey and by camel caravan to the towns and villages for use as fuel to supplement a very limited supply of coal, animal dung, and charcoal. The latter is prepared from the remnants of a forest on the Caspian side of the mountains on the north and from scattered timber that is still available in the rough, high mountains along the southwest border. This wasteful practice leaves the landscape destitute of vegetation except in the village oases that have been developed under irrigation.

Perennial streams flow into the Caspian Sea from mountains on the north that range in elevation up to 19,000 ft. Other and larger perennial streams flow into the Persian Gulf from the mountains on the west and southwest. In the interior and on the east, runoff from light winter snow, and from occasional spring rains, feeds and sustains a limited ground-water supply in the long alluvial fans that extend from the mountains and low hills into the desert. There are very few small perennial streams in the interior, but a vast development of ground water has been made through the thousands of years since the time of Cyrus and Darius, and the days of the Medes and the Persians long before the year one.

Irrigation is the beginning and the end of agriculture in Persia, and over 80% of it is from ground water. This development has been extremely slow and laborious. The system is unique and seems to be peculiar to Persia. It is known as the "kanat system" of ground-water development, by which water from a perched water table is brought to the surface by gravity. Test wells are dug by hand at various locations on alluvial slopes, down to the water table. By crude methods of leveling, the kanat specialist, who is usually the son and son's son of kanat specialists and diggers for long generations back, determines where this water supply can be brought to the surface by gravity. At that point he starts a crew to work. They dig an open ditch up the slope, allowing just enough fall for water to flow.

Finally the ditch is too deep to permit of further economical or practical digging. At that point the crew begins burrowing a small tunnel just wide and high enough to admit the body of a small man in a crouched position. The excavated material is placed in buckets made of rawhide and a helper drags them to the mouth of the tunnel, where they are hoisted to the surface by another helper. Thus the burrowing continues for a distance of 30 meters or more, at which stage the kanat specialist locates a point directly above the end of the excavation, where a well is dug to the kanat. Through this well the excavated material for an extension of the kanat is hoisted. This well also serves as a ventilator; otherwise some artificial or mechanical means of supplying air to the "ground-hot" workers would be necessary, and they have not perfected any such system in the 4,000 years or more since the first kanat was dug. This process is continued on up the slope for a distance of from 1 to 10 kilometers.

From the first well the burrow-

KARUN RIVER DAM AT SHUSHTAR, IRAN, CONSTRUCTED BY ROMAN PRISONERS

ing continues deeper and deeper below the surface, with outlet and ventilation wells 15 to 20 meters apart. Finally ground water is encountered. Without changing grade, the excavation is carried forward until it is well below the surface of the ground-water table, thus developing an infiltration gallery into which the water percolates and flows to the outlet, where it is carried to a suitable tract for irrigation. After two or three years of digging, sufficient water is developed to supply lands for a small village. In most cases three or more individual kanats, each of which may have several branches, are dug to supply water for a single village of 1,000 to 5,000 hectares, operated by 1,000 to 20,000 people may require years for completion.

REMAINS OF AN ANCIENT DIVERSION DAM ON THE KARUN RIVER, OF ROUGH MASONRY BONDED BY "ROMAN EARTH"; ANCIENT CASTLE IN BACKGROUND

Usually the village or a string of villages is owned by a single individual or family who rents the land and water to the peasants. The owner furnishes the land, the water, the seed, and the oxen for plowing, and takes one-fifth of the crop for each of these services. Thus the peasant gets only one-fifth for his labor. There are more than 43,400 villages in Iran. In fact the agriculture of the country is carried on by this type of development. There are very few if any individual farms operated independently by the owners.

Water is the limiting factor in the life and welfare of Iran, and the population has reached a stage where there is a shortage of food. Many of the villages are overpopulated and the larger cities are crowded with people who are hungry and cold during the winter months when food and fuel are most scarce. To alleviate this situation, an effort is now being made to provide supplemental water for village lands and to enlarge and expand the irrigated areas around centers of population. The repair of thousands of kanats that have been partially destroyed through lack of maintenance is a problem requiring attention.

ENGINEERING PHASES OF IRRIGATION

Except for the fact that cement and steel are not readily available, the engineering phases of the irrigation problem are not particularly difficult. There is a wealth of opportunity for improvement and expansion of the irrigated area by utilizing the surplus waters that now go to waste in winter and early spring. So far as I have been able to determine, there is not a storage reservoir in the entire nation. In ancient times, a limited number of storage reservoirs were in use, but the dams were destroyed during periods of invasion, following the reigns of Cyrus and Darius, around 500 B.C. For more than 1,000, possibly 1,500 years, the country has been entirely without the benefit of storage for surplus winter and spring runoff.

In searching for suitable reservoir sites, I found the remnants of dams in three different and widely separated districts. The history, even the knowledge of their existence, has been entirely lost, and local inhabitants were surprised when I showed them the remnants of the old dams. One of these is an earth fill more than 3 km long and 3 to 6 m high. Three operations are required to put the reservoir in active use: (1) repair of the break in the old dam and the building of an outlet control; (2) the building of a diversion canal for carrying flood waters to the reservoir; and (3) rebuilding of the old delivery canal to the agricultural lands surrounding a modern sugar factory, now faced with the necessity of closing for want of sufficient hectorage of beets in the vicinity.

Isfahan, the ancient capital of Persia, referred to in ancient Persian literature as "Half of the World," lies in the center of a beautiful river valley some 150 km long. The valley is irrigated by direct diversion from Zayendeh Rud (River) and from a series of very old kanats. In midsummer the water supply is so meager that it reaches only the upper districts.

On June 1, 1942, I was successful in bringing about an agreement by which I was given full control of the river for fifteen days. During that time the upper canals were closed and most of the flow was taken to the seventy or more downstream villages. Crops were saved and a partial or total famine in that district was prevented. This helped also to relieve the food shortage elsewhere. Such an expedient is effective only under impartial and unbiased leadership. The only permanent relief is more water. To meet this situation, a very good site has been located for a storage dam, and work on the road leading to the dam site has been started.

In designing a dam such as the one now under consideration, the practical engineer must take many factors into account. Chief of these, in addition to lack of cement and steel, is the fact that there is no modern equipment for use in transporting materials. All must be moved by camel or donkey or in crude horse or ox carts. For this reason we are balancing the cost of a standard earth-fill and rock-riprap dam against a masonry arch with gravity-type abutments at each end, mortar for the stone masonry being made from "Roman earth" which is a kind of cement made from lime and burned clay. Many old structures in this country, which were made in this way, have stood the test of time during periods of 1,500 to 2,500 years or more; therefore it seems entirely without risk to use the same methods today, with some modern improvements, such as portland cement concrete in the exterior course and for pointing all exposed faces of masonry work.

Another method of construction being considered is a combination of placed dry stone on the upstream and downstream faces with earth fill between, the fill to be placed by a hydraulic process so as to deposit the coarse materials in the downstream third and the finer materials in the upstream two-thirds of the dam. One dam site has been located where this process will be ideal since

RUINS OF ANCIENT CASTLE BUILT AT SHUSHTAR, IRAN, WHEN IT WAS THE CAPITAL OF PERSIA, OVERLOOK DAMS SHOWN IN OTHER VIEWS

there is an abundant volume of earth-fill material directly above the dam site. A ditch from a large spring far above leads to the alluvial fan from which the fill can be sluiced into place. On the other end of the dam site is an abundant supply of loose rock sufficient for the two faces of the dam, which would be placed in successive lifts in advance of the hydraulic fill.

Thus it is possible to take advantage of natural conditions and build structures that would be prohibitive in cost if designs were confined to standard engineering practice. There are a few old tractors that might be repaired, but the cost would be very heavy because of lack of parts. There are no draglines or shovels, power scrapers or rock drills. The engineer must resign himself to conditions as they are and modify his plans to meet the requirements. After many years of practice in the States, under conditions where funds were extremely limited, this experience is not entirely new to me.

TWO SERIOUS HANDICAPS

In addition to the factors already mentioned, there are two conditions that constitute a serious handicap to progress. The finances of the Government are extremely limited and the formalities required by the Ministry of Finance, which controls all regular transactions of all ministries, are so cumbersome and inoperative that it is virtually impossible to carry on a job of any kind with any degree of efficiency or success. In making one single purchase of a minor nature the writer had to obtain the sanction or the signature of individuals or chiefs of divisions in 28 separate offices, and the operation required three days of constant effort after the regular force had already spent two weeks on the problem.

The other handicap to progress is the lack of security. There is a tendency on the part of the local officials to plan only from day to day or at most from season to season, for the reason that no one feels that he is secure against raids by bandits or hostile neighboring villages or tribes, or that the Government is sufficiently secure to justify the outlay of funds for permanent improvements. In 1942 there was an abdication, an invasion, and four successive changes in cabinet in the Iranian government. Travelers on the main highways are attacked, robbed, beaten, even killed, and very little or nothing is done to prevent recurrences, or to apprehend and punish participants in these outrages.

In the remote sections, tribes rob, plunder, and kill each other, or unite in robbing distant villages and travelers, all of which makes field studies and operations rather difficult and expensive. A military escort is required for each expedition, including survey parties and any job of construction that is removed from centers of population. Recently at a point only 18 km south of Isfahan, on the main highway, over which my party had passed only a few hours before, a wholesale holdup, robbery, and killing took place. A colonel and his sergeant were killed, among others.

On two occasions my investigations have taken me far into the mountains where the tribes have control and defy the soldiers to come and get them or to collect revenue from them. Most of these men are armed and they are never separated from their guns for a minute, night or day. Thus far I have gone about unarmed and have been successful in convincing the chiefs of tribes that mine is a mission of peace and helpfulness. On one occasion, as an act of unusual courtesy, the entire armed force of one tribe accompanied me out of the mountains to the valley below. Five of the men were on foot and seemed to have no trouble in keeping up with the horses over the rugged mountain trails for over 20 km.

We had remained at the mountain camp from 10 in the morning, at which time I had finished my observations, until 1:30 in order to allow time for killing the fatted lambs and kids and for preparing a special feast in honor of our visit. Little by little we are making friends with the tribesmen, who, when once they are convinced of one's sincerity of purpose, are very profound and demonstrative in their courtesy and hospitality. Nevertheless and notwithstanding, rifles are ever present, even on the backs of waiters preparing and serving the feast.

This extremely unsettled condition makes it difficult to plan a program of development with any assurance that it can be executed; and there are so many problems that are crying for attention. For example, on the River Kur below the sugar factory to which reference has been made, there are six old masonry diversion dams that supply water to some sixty or seventy villages. Two of these dams have already ceased to function and two more are in serious need of repair. Many of the villages are already deserted and the people of four others refused to plant winter wheat last fall, because the peasants realized that, without repair, the old dam that supplies not only water to 14 canals but also turns 14 or more millstones will cease to function before the next flood season is over unless it is repaired now.

In the plain leading down to the junction of the Euphrates and Tigris where the city of Ur was located, and a short distance below Babylon, lies another lovely body of land on the Persian side of the valley. Here a dam was built hundreds of years ago by conquered Roman soldiers, each of whom was required to bring a bag of "Roman earth" to the site. This old dam is in ruin and needs repair in order to provide water for a string of many villages and a long body of fertile land. In this same locality, on another stream farther to the north, the river channel has deepened past the old intake to an ancient canal that covered many thousands of hectares. A little work under competent supervision would restore this ancient irrigation system and provide homes and food for tens of thousands of hungry people.

These and other problems too numerous to mention serve as the incentive to spur the engineer on, even in the face of what might at first seem to be insurmountable difficulties in this the oldest part of the civilized world and the area where irrigation had its birth.

Capacity of Trinity River Levee System

Reduction of Flood-Plain Area at Dallas, Tex., by Levee Construction Compensated for by Channel Improvements

By Trigg Twichell, Assoc. M. Am. Soc. C.E.
Hydraulic Engineer, U.S. Geological Survey, Austin, Tex.

Looking Upstream from Commerce Street Bridge Before Channel Rectification

STREAM-flow records on the Trinity River at Dallas, Tex., prior to and subsequent to the construction of a levee system in 1930, now provide basic data of considerable interest to the engineer. They apply particularly in connection with recorded discharge and probable capacity of the levee system (Fig. 1).

As a matter of record and for comparison, current-meter measurements of flood discharge and reliable records of stage were obtained in 1922 and twenty years later, in 1942. These clearly show that the flood discharge capacity of the leveed channel is equal to that of the abandoned natural river channel and flood plain for comparable flood stages. Theoretically speaking, this of course is not surprising, since obviously the improvements should maintain the hydraulic value of the channel. What is surprising, however, is that this has been accomplished in the face of an actual decrease in the rectified channel width and area to about 25% of those of the natural valley at extreme flood stages.

A second finding of interest was brought out by the corresponding records taken at the Commerce Street Bridge. These data indicate that the reach of channel which controls the stage-discharge relation at the Commerce Street Bridge is in a large measure below the levee system and was not changed by its construction.

The old channel was formed by the confluence of the Elm and West forks, 5 miles upstream from this bridge. The flood plain is 14,000 ft wide at the confluence of the two forks, but narrows to 8,700 ft at Commerce Street and to 4,800 ft at the Gulf, Colorado, and Santa Fe Railroad, 2.9 miles downstream. Then the valley again widens. Flood waters are now confined within the leveed channel, which varies in width from 3,000 to 2,000 ft (Fig. 1).

Topographic maps show a natural valley choke near the lower end of the levee system, as outlined by the 1908 flood line. Before the construction of the levees, flood discharges of 20,000 cu ft per sec or more caused overflow onto the flood plain. The leveed channel below the original confluence has reduced the channel distance from 7.9 to 5.0 miles.

Current-meter measurements defining stage-discharge curves before and after the construction of the levees in 1930 show that the new channel at Commerce Street was well designed with respect to discharge capacity. The designed capacity is more than twice the peak flow of the largest flood known, that of May 25, 1908, when the discharge was 184,000 cu ft per sec. This peak discharge was determined by an extension of the rating curve based on flood measurements made before the channel was changed. As the flood measurements before and after the change agree, it is reasonable to assume that a discharge of 184,000 cu ft per sec would at this time reach the 1908 stage at the Commerce Street gage.

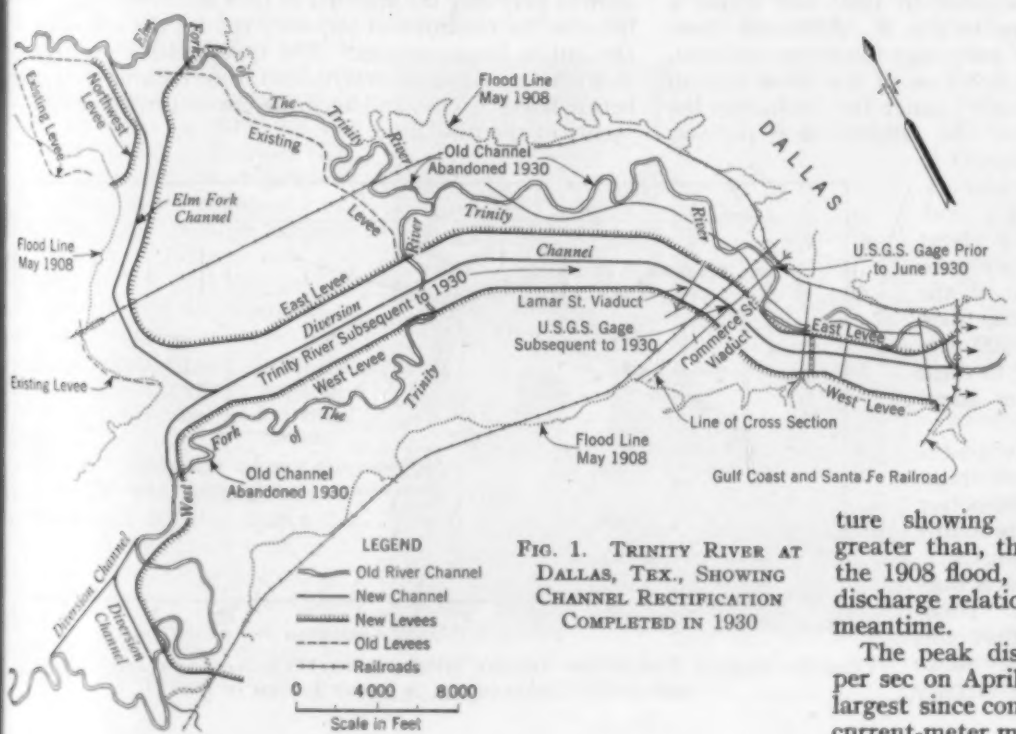


Fig. 1. Trinity River at Dallas, Tex., Showing Channel Rectification Completed in 1930

A tangent extension of a rating curve defined to 110,000 cu ft per sec by current-meter measurements made in 1942, and a similar extension through measurements made prior to 1930, indicate that the rectified channel will now carry 170,000 cu ft per sec at the height of the 1908 flood. This is conservative, and probably is the lowest discharge that could occur at that stage. The rating curve when fully defined will probably have a positive curvature showing discharge equal to, or greater than, the estimated discharge of the 1908 flood, assuming that the stage-discharge relation does not change in the meantime.

The peak discharge of 110,000 cu ft per sec on April 26, 1942 (Fig. 2) is the largest since completion of the levees. A current-meter measurement made at the

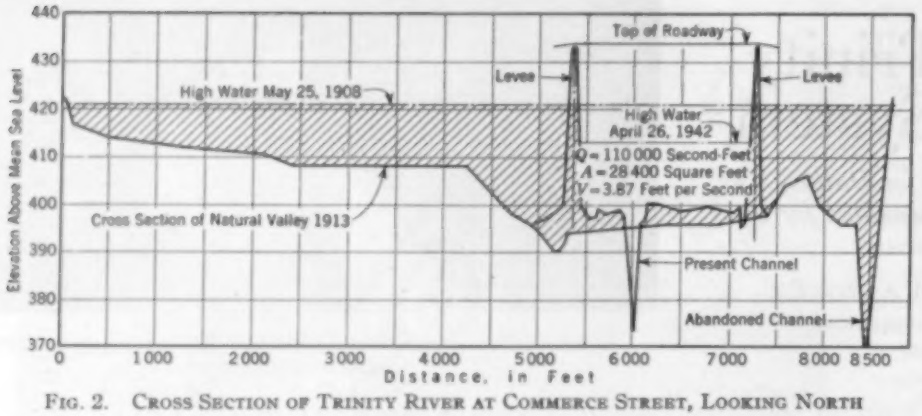


FIG. 2. CROSS SECTION OF TRINITY RIVER AT COMMERCE STREET, LOOKING NORTH

peak stage indicates that the discharge was practically the same within the leveed channel at Commerce Street as it would have been at the same stage without the levees and with the water extending over the 8,000-ft width of the flood plain.

The U.S. Geological Survey, in cooperation with the Texas Board of Water Engineers, has maintained a stream-flow measuring station at the Commerce Street crossing almost continuously since October 1, 1920. The present gage inside the levee system uses the same datum as the old gage. Prior to the construction of the levee system, the old gage was rated to a stage of 42 ft. Subsequently, and through the flood of 1942, measurments have defined the rating curve of the new gage up to a stage of approximately 46 ft. The plotting of these measurements (Fig. 3) indicates that there has been no appreciable change in the rating curve, between 34 and 46 ft in stage, before and after levee construction except for one flood in 1941. (See measurements at 30,000 and 55,000 cu ft per sec.) No attempt was made to rate the new gage until the pilot channel had been scoured out and appeared to be reaching a fairly stable condition.

Discharge measurements defining the high-water curve above a 34-ft stage were made in 1921 and 1922. Two measurements made in 1930, plot 13% high in discharge (25,000 and 34,000 cu ft per sec). All flood measurements made subsequent to 1930 and above a 32-ft stage are also plotted in Fig. 3. Although these indicate some shifting of the stage-discharge relation, it is evident that the construction of the levee system did not make an appreciable change for discharges between the limits of 28,000 and 110,000 cu ft per sec.

The two high measurements in 1941 were made June 13 and 14, on a falling stage following a peak of 42.90 ft. As they plot about 1.5 ft above the curve, they indicate a temporary shifting of the high-water control. All other flood measurements between 1920 and 1942, prior and subsequent to these two, check the high-water curve closely.

The close agreement between the rating curves above a 34-ft stage, before and after the construction of the levee system, is probably due to one of two conditions:

1. The controlling reach may be below the levee system. Topographic maps indicate that this control is the natural valley choke about 4,800 ft wide in the vicinity of the Gulf, Colorado and Santa Fe crossing (Fig. 1). Bridges across the valley choke may possibly be included as part of the control.

2. Reduction of the large flood-plain area by the construction of the levees is compensated for by channel improvements within the levee system. The original flood plain contained thick growths of low brush and trees. For floods covering the wide overflow area, the velocities probably were low, possibly zero in some sections. Thus most of the discharge would have been conveyed by the main channel and adjacent sections, or by the main channel and isolated sections in the overflow where velocity conditions were favorable.

Should the rectified channel not be properly maintained, and should brush and trees be allowed to choke it, the control for flood stages under the first of these conditions may move upstream into the rectified channel and require higher stages to pass future floods. Except for defining the stage-discharge relation for the gage at Commerce Street, reliable hydraulic factors of the rectified channel have not yet been obtained. The U.S. Geological Survey has secured some slope data over one channel reach, and has determined head losses through the Commerce Street Bridge for some stages, finding them to be negligible. It has also developed cross sections and determined velocity distributions at the Commerce Street and the Lamar-McKinney Street bridges from the results of current-meter measurements. These data, however, are not yet in sufficient detail to permit the determination of the hydraulic factors used in the various slope formulas.

It will be seen that the hydrographic data already collected sustain the engineer's design as regards the ample channel capacity. Similar data to be collected in future years will aid in the proper maintenance of the levee system. Willow trees and small brush are growing within the leveed floodway. If permitted to continue, this growth may clog the channel so that the lower reach may become the control and seriously reduce the efficiency of the entire levee system. The quantitative changes in this efficiency can be determined from reliable records of future flood heights and accurate current-meter measurements of the discharge.

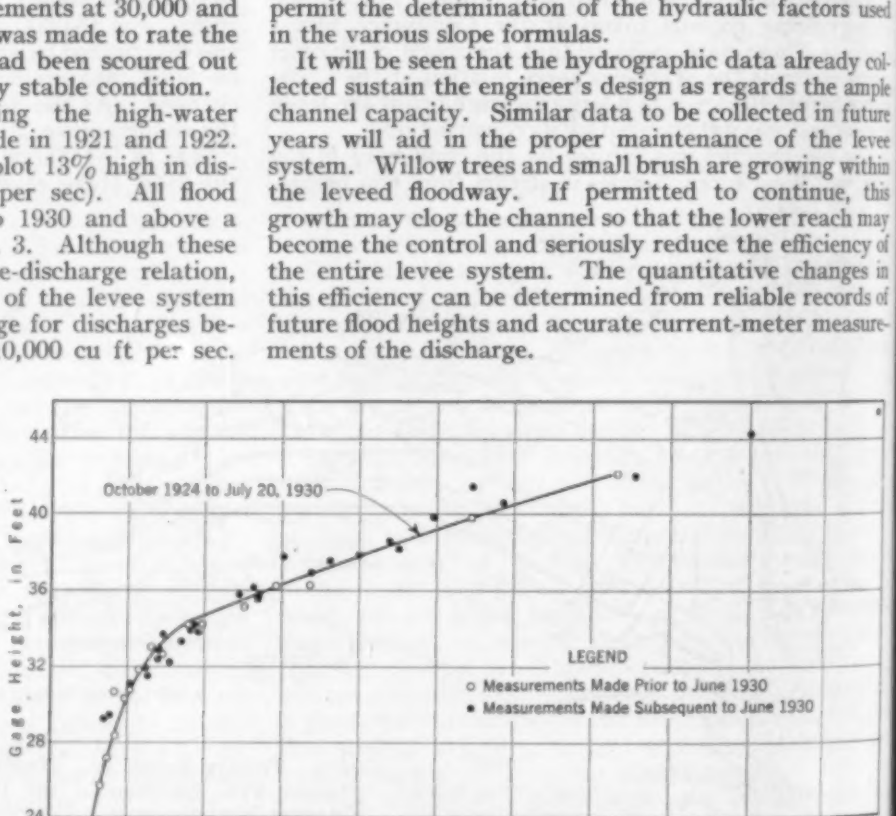

October 1924 to July 20, 1930
LEGEND
o Measurements Made Prior to June 1930
• Measurements Made Subsequent to June 1930
Gage Height, in Feet
Discharge, in Thousands of Second-Feet

FIG. 3. RATING CURVE FOR TRINITY RIVER, FROM MEASUREMENTS BOTH BEFORE AND AFTER CONSTRUCTION OF LEVEE SYSTEM IN 1930

Deep Caissons Support River-Side Power Plant

Foundations Extended by Drilling Through Boulders and Shale Into Rock at Williamsburg, Pa.

By Charles B. Spencer, M. Am. Soc. C.E.
Vice-President, Spencer, White and Prentis, Inc., New York, N.Y.

ENGINEERS entrusted with the design of important structures have found that they cannot predict an absence of foundation problems from the performance of nearby buildings. Subsoil conditions in many localities vary greatly within small areas. Such a case was encountered in the construction of the Williamsburg Station of the Pennsylvania Edison Company. The use of drilled-in caissons, as described by Mr. Spencer, provided an adequate foundation for heavy generating equipment.

A NOTABLE example of a project which apparently involved no foundation difficulties, but which actually developed problems taxing to the utmost the ingenuity of the engineers, is the recently completed addition to the Williamsburg Station of the Pennsylvania Edison Company of Altoona, Pa. The original station was built in two sections in 1914 and 1920. In 1942 the owners engaged the services of Burns and Roe, Inc., to design and build an addition which would more than double the capacity of the station at normal load, and nearly triple its capacity at peak loads. The record plans showed that the present building was carried on concrete footings bearing on firm clay about 10 ft below grade. There were no indications of settlement of any consequence despite the fact that the nearby Juniata River had occasionally reached a stage high enough to flood the basement floor.

Borings at the site disclosed that the top of the shale underlying the firm clay fell away rapidly in the northwest corner of the premises. The clay at this point was similar to that supporting the existing building. This material was, however, of less carrying capacity below the ground-water level. Furthermore, since the greater portion of the new building was supported on shale, the entire structure should be carried on the same rock to avoid uneven settlement. Four methods were available for reaching the shale, which lay as much as 75 ft below the excavation subgrade—open excavation, pneumatic excavation, pipe piles, or drilled-in caissons. Because of the hazards of the first, the cost of the second, and the chance that the large number of pipe piles required would be held up on the numerous boulders, it was decided to use drilled-in caissons.

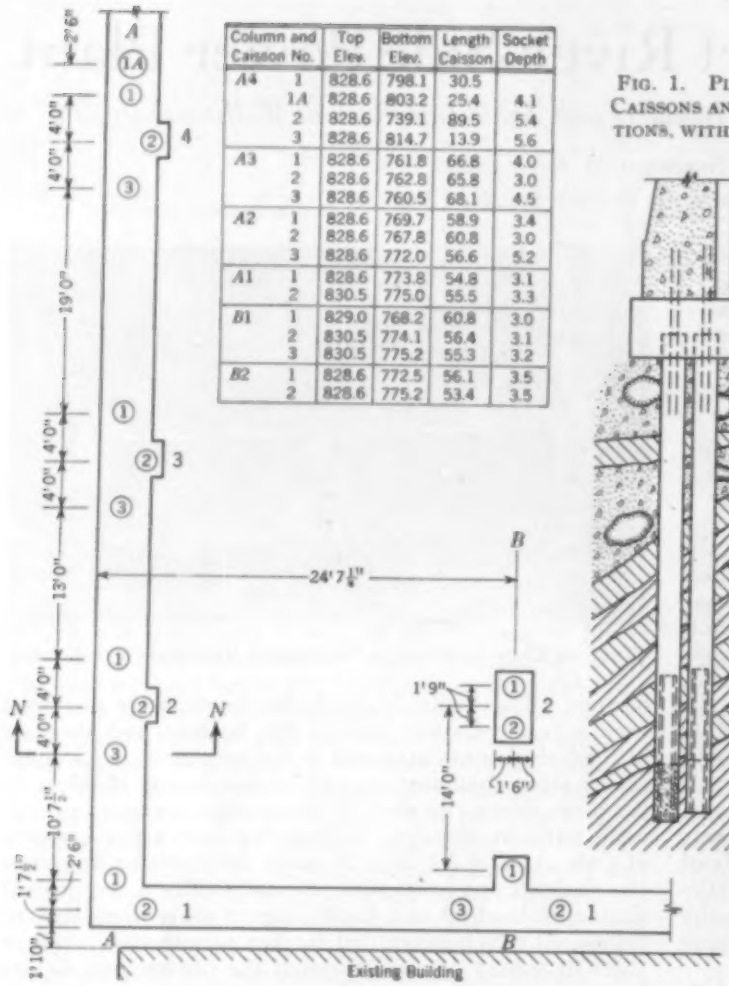
Sixteen caissons were installed for the support of 6 columns and 100 lin ft of wall. Because of availability of material and conditions of loading, the cylinders were 18 in. in diameter, and the contract was based upon lengths interpolated as accurately as possible from the borings. The shells, $^1/_2$ in. in thickness, were provided with a heavy driving shoe at the bottom, and were set in rigid steel leads attached to a steam crane. A single-acting steam hammer, capable of developing 15,000 ft-lb per blow, drove the shell as far as was cons dered practicable without damage. Only in the case of five caissons at Cols. A1 and A2 (Fig. 1) could the shells be driven to the shale in one operation. Usually after a few feet of driving, a boulder or a band of hard shale would be encountered which prevented further penetration. It was then necessary to drill through the obstruction before further penetration could be accomplished.

Test on 12-in. Caisson to Determine Resistance to Uplift

Alternate driving and drilling were continued until rock of a quality adequate to carry the caisson load was encountered. The extreme variation in depths is shown in Fig. 1. It is interesting to note that in the case of Col. A4, cylinders 6 ft 6 in. apart varied in length by about 75 ft. This would be almost unbelievable except that an identical condition is visible from the site within a few hundred yards. On the other side of the river the ground rises sharply, and while the usual condition is a steep hill, at intervals "walls" of shale rise almost vertically to a height of 50 ft or more. Evidently this is the condition in the foundation.

When the shale ledge was finally reached, sockets were drilled to a minimum depth of 3 ft. The purpose of the socket is twofold: not only is anchorage provided against slippage on the sloping rock, but the loading is transmitted into the sides as well as the bottom of the socket. It has been established by actual test that the bond between the concrete and the sides of the socket is in excess of 400 lb per sq in. In fact, in high, narrow structures the anchorage fur-

Driving and Drilling Rigs Which Place 18-In. Steel Caissons



Column and Caisson No.		Top Elev.	Bottom Elev.	Length Caisson	Socket Depth
A4	1	828.6	798.1	30.5	
	1A	828.6	803.2	25.4	4.1
	2	828.6	739.1	89.5	5.4
	3	828.6	814.7	13.9	5.6
A3	1	828.6	761.8	66.8	4.0
	2	828.6	762.8	65.8	3.0
	3	828.6	760.5	68.1	4.5
A2	1	828.6	769.7	58.9	3.4
	2	828.6	767.8	60.8	3.0
	3	828.6	772.0	56.6	5.2
A1	1	828.6	773.8	54.8	3.1
	2	830.5	775.0	55.5	3.3
B1	1	829.0	768.2	60.8	3.0
	2	830.5	774.1	56.4	3.1
	3	830.5	775.2	55.3	3.2
B2	1	828.6	772.5	56.1	3.5
	2	828.6	775.2	53.4	3.5

FIG. 1. PLAN OF DRILLED-IN CAISSONS AND SUBSOIL CONDITIONS, WITH PERTINENT DATA

nished by this bond is extremely useful in providing against uplift.

In many drilled-in caisson operations the heavy unit loadings require the use of a steel core extending to the surface. In this case the purpose of the core was only for anchorage and distribution of the load into the rock. The cores, consisting of 10-in. H-beams, extended from the bottom of the socket to about 4 ft above the shoe. In a few cases the cores were grouted in place in the dry. In most instances, owing to the considerable inflow of water, it was felt that better results would be obtained by setting the core under water and grouting with a tremie bucket. Subsequently, 4,000-lb per sq in. concrete was deposited in the shell to grade.

Despite the obstructions described, all but one of the caissons were successfully installed. In Col. A4, which was on the edge of the "cliff," one of the shells was damaged so as to impair its capacity, and was replaced by another. The tops of all cylinders extended 18 in. into the concrete foundation above, and were doweled in by four 1-in. square rods. During the work, extreme variations were noted in groundwater conditions throughout the premises, chiefly because the Juniata River is subject to great variations in level. Previous to this work a temporary dike had been installed up to El. 845, or about 4 ft below the main floor of the adjoining building. During the underpinning installation, this dike was overtopped by several feet and the entire site was under water. While such floods did not appear to affect the ground-water level greatly, a considerable quantity of water under pressure was found in pockets. The driving of the caissons usually produced a flow of water alongside, and in some cases the water would rise in the cylinders to a point several feet above grade. These conditions gave the engineers considerable concern as to the safety of their basement slab. Not until completion would the structure have sufficient weight to resist a full head of water at flood stages, and a floor adequate to transmit such pressures to the wide-spaced columns was not contemplated in the design.

The first plan was to anchor the slab to the rock by means of the drilled-in caissons in the non-rock section, and specially installed anchors in the rock section. The contractor was directed to install an experimental anchor 12 in. in diameter, drilled 20 ft into the rock and belled to 16 in. at the bottom. Ten 1-in.-diameter rods were set and concreted in place. This anchorage was successfully tested with hydraulic jacks to 137 tons, the approximate capacity of the rods. However, the number of anchors required would be so large and the expense so great, that a permanent drainage system was substituted.

It was felt that with the site sealed as far as practicable around the exterior, the ingress of water even at flood stages would not be serious. The excavation was carried down 18 in. farther and a layer of gravel deposited beneath the floor slab. Porous tiles laid in the gravel lead to two sumps about 8 by 8 ft.—one containing a pump of 1,000-gal capacity. Thus any water can be removed and at very low cost.

DRAINAGE SUMP REDUCED UPLIFT ON STRUCTURE
Underpinned Footings in Background

Engineers and constructors of the power station were Burns and Roe, Inc., represented by J. A. Freiday and P. J. McCoy, and by F. L. Jones, field superintendent. In charge of the work for the owner were William H. Wade, vice-president, and Elmer F. Reed, production manager. The foundation contractors were Spencer, White and Prentis, Inc., of New York, who were represented by Harry Armstrong and Michael E. Kenny, superintendents, and by Daniel J. Barrows, Assoc. M. Am. Soc. C.E., field engineer.

Design of Camouflage Nets

From Paper Presented Before the Structural Division at the Society's Los Angeles Convention

By S. B. BARNES, M. AM. SOC. C.E.
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DESIGN of protective concealment for an industrial plant becomes an interesting engineering problem when netting and supports are required. Netted areas on any one project may exceed five million square feet and may be used to conceal property valued at many millions of dollars. The design of netted areas of this size calls for the use of mass-production methods and heavy equipment as contrasted with the hand construction used by the Army to conceal small field installations, as where a platoon is called out to erect a covering with materials at hand in the surrounding countryside. Similarly the structural design for these large areas must be made in accordance with sound engineering principles rather than left to guesswork or the practiced eye of a field man, because a failure may cause extensive damage or delay in the war effort.

Garnished netting may be used to cover a large industrial plant in such a way that its true form, color, and texture is concealed or changed and tell-tale shadows eliminated. This netting is usually garnished and painted to simulate a pattern which it is hoped will deceive the enemy.

One of the prime requirements of a protective concealment project is that it must not interfere with the production of the plant. In California, where so many factories use outside production lines, our first big problem is to find a plan whereby netting supports can be placed without interfering with the movement of factory materials. This often necessitates the use of spans from 200 to 250 ft or more.

The necessity for long-span construction has led to the use of a suspension system of wire rope to support the netting. Generally speaking, such a system consists of secondary cables spaced from 6 to 10 ft apart on centers, supported by girder cables attached to poles. All cable pulls are balanced around each pole and dead ends are guyed or strutted to the ground.

LOADING VARIATIONS

When material used for netting was weighed wet and dry, considerable difference was found in the weight, which varied from 0.12 to 0.30 lb per sq ft. Designs for dead loads have been based on $^1/_3$ lb per sq ft, no snow load being necessary in the locality involved. The question of wind loads on this kind of structure is of utmost importance. Wind-tunnel tests were made on very small pieces of netting. As a result, the design has included a drag load due to wind of 0.5 lb per sq ft of horizontal netted area. Statically, the uplift force does not exceed twice the design vertical load and therefore does not govern. It does have other effects, such as the creation of vibratory conditions, which will be dealt with later.

A typical net support system is illustrated in Fig. 1. In this system the netting is attached directly to the girder cables or "G" cables. In this type of system it is essential that sags be kept small to avoid a tent-like appearance. For this reason it is not unusual to find dead load stresses of the order of 20,000 to 30,000 lb in girder cables. When a wind drag over an area of 100,000 sq ft, or 50,000 lb, is added, the stresses involved reach sizable totals. Cables are dead-ended in pick-up cables labeled "F" cables on the sketch. These cables have a horizontal sag which we have attempted to limit to 12 ft, or the width of 2 rolls of netting.

Cross winds increase the longitudinal pulls on certain cables so that corner pole guys often are both working to maximum conditions due to a wind in one direction. Thus it is not infrequent to find corner poles carrying vertical loads of 150,000 to 200,000 lb, all to support a netting weighing not over $^1/_3$ lb per sq ft. The sketch layout shown in Fig. 1 is an ideal condition rarely met with. More often clearances require uneven trapezoidal or triangular pole spacing.

No new engineering fundamentals are involved in this type of design. It certainly gives good practice in the resolution of forces, however, both in one plane and in three dimensions. All pole pulls must be balanced, not only for vertical load conditions but for wind. Because unbalanced conditions may occur locally, a movement of 1 to 2 ft at the top of poles is allowed for in the design. This permits a pole to sway slightly and automatically balance local eccentric pulls of short duration.

In some cases it is desirable to suspend the secondary cables from primary supporting cables. This makes possible the use of greater sags and smaller vertical-load stresses in the main cables and permits a netting line more nearly flat. It requires taller poles, which have to

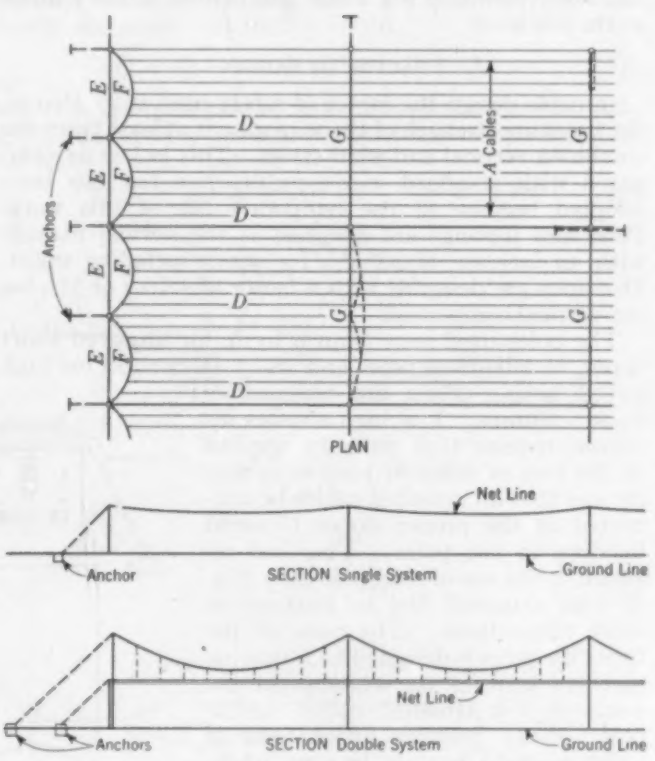

FIG. 1. ARRANGEMENT OF CABLE NETWORK SUPPORTING CAMOUFLAGE MESH

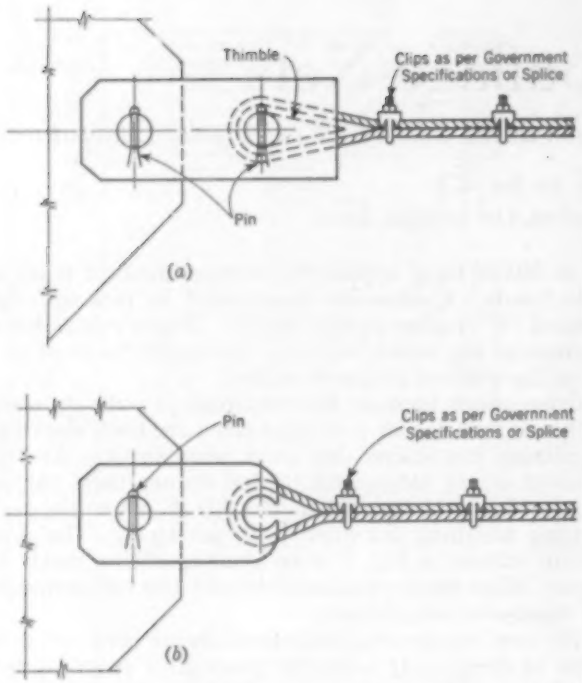

FIG. 3. CABLE CONNECTIONS: (A) SHACKLE AND THIMBLE, (B) "SHIMBLE"

be quite large to meet the necessary L/b values, or may require trussing. The main wind stresses are carried through the horizontal cables rather than through the primary cables. The wind cables on the pole lines are made to slide free at the intermediate poles so that the differential pulls due to wind between high and low cables will not break the poles. For the same reason, at the dead-end positions, separate poles are used for the high and low systems, or if a single pole is used, it has a hinge at the low level.

FACTOR OF SAFETY

In cable design the factor of safety used is 2; that is, the breaking strength of the wire rope is at least twice the combined vertical and wind stress. This is low as compared with standard wire-rope practice but has been adopted because of the temporary life of this work. Poles and footings are designed in the normal manner with an increase of $33^1/_3\%$ for wind, including uplift. Deadmen are designed with a factor of safety of $1^1/_2$ for the vertical component.

The poles used vary from 6 by 6, for unguyed short types, to telephone poles and 18-by-18 timbers for high guyed poles. These are designed as wood columns. The high stresses involved require that pulls be applied to the tops of poles without eccentricity and that all attached cables be connected at the proper slopes to avoid bending in the poles. This has resulted in the use of steel pole caps (Fig. 2) with attached fins to receive the cable connections. The plate at the top of the poles is designed as a bearing plate to transfer the vertical components of the attached cables to the pole. Many peculiar adaptations of poles and guys have to be used where clearances dictate locations. Sloping poles and vertical guys, or two sloping poles with a vertical guy, are quite common. In order to isolate possible failures, dead-end guys are provided at intervals of 500 ft or less, so designed that if the cables on one side are cut, the rest of the system will remain stable.

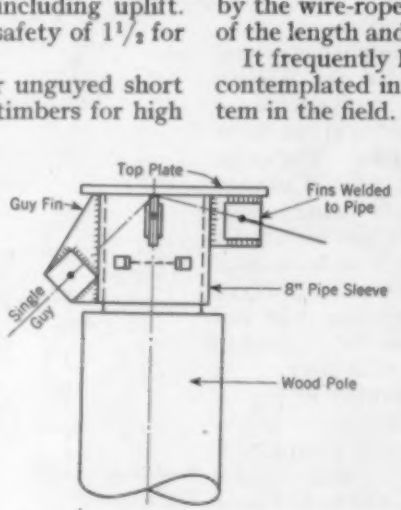

FIG. 2. POLE CAP DESIGNED FOR CABLE CONNECTIONS

TURNBUCKLES AND CONNECTION DEVICES

Turnbuckles are required in each cable connecting poles and sometimes in each 500 ft of secondary cable. Tests were made on standard turnbuckles and they were calibrated according to the various sizes of wire rope used so as to give equal strength. For special connections, home-made turnbuckles have been used incorporating clevis and thimble ends.

Because of the low factor of safety used for the wire rope, it was essential that all fittings be carefully designed. Very few standard fittings were found available for this work. Special clevises and thimble connections were designed (Fig. 3) to meet the special requirements. One manufacturer has designed a special combination shackle and thimble which he calls a "Shimble," and which seems to be satisfactory and economical.

The design of wire ropes is, of course, very simple. The cable assumes the shape of the moment diagram of a beam on the same span with similar loading. The horizontal component of the wire-rope stress is the moment in the beam divided by the sag. Where forces both normal to and parallel with a cable are applied, the stress solution may require simultaneous equations. The designs are usually made assuming a given stress and solving for the sags at critical points.

Our network drawings list by schedule the stresses, vertical sags, tangents at each end, required breaking strength of wire rope, and suggested or recommended wire-rope size. The tangents at the ends are listed to aid the shop detailer on pole caps and deadmen anchors. Tangents are limited in some cases to fit into the camouflage pattern.

Field determination of cable lengths is one of the most important items for the erection contractor. Cables must be cut to such a length that when loaded they will have the proper sag within the range of the turnbuckle take-up. This involves a "guestimate" of the non-elastic stretch of new wire rope due to the tightening of the fibers as well as an estimate of the elongation of the wire rope under load. Because of the low modulus of elasticity, this item is considerable. For example, a cable of 100-ft span under a stress of 20,000 lb per sq in. will stretch elastically approximately 2 in. Inelastic stretch is given by the wire-rope catalogues as between $^1/_4$ and $^1/_2$ of 1% of the length and varies with the type of wire rope.

It frequently happens that certain loads not originally contemplated in the design are applied to a netting system in the field. In such cases, cable spans, of course, require more than the listed design sag if design stresses are to be maintained. However, if this particular span is one in a series of spans in which there is one normally loaded span, and if the normally loaded span has the correct sag, then all spans must have the correct sag or they will be out of balance. This usually requires some adjusting or slipping of cables over supports, and holds true for all practical purposes until the change in slope at cable ends becomes appreciable.

The low modulus of elasticity of wire rope becomes an inherent factor of safety for special loads inasmuch as in any fixed span, if the unit fiber stress is

increased, the stretch is increased. The increased stretch in turn will increase the sag and thus reduce the stress below that computed on the basis of the original sag.

FLUTTER DAMPING

It was possible to observe the effect of extremely high winds on one such system after erection. Uplift on one span released a balancing tension on the adjacent span causing a vibratory action in which alternate spans experienced decreased or negative sags while the spans between had increased downward sags. This particular wind was the highest ever recorded in the vicinity and caused no structural failures, although some netting was blown off the cables. Nevertheless attempts are being made to dampen out such vibratory motion.

To this end one project has 2-by-3 or 2-by-4 timbers attached to the cables to act on a small scale like the stiffening trusses of a suspension bridge. Other projects have introduced snubber connections at poles so that reverse sags due to wind will not have the same period of vibration upwards as downwards. The temporary nature of this work has to be weighed against the expense of a damping system and the probability of failure and damage due to infrequent wind storms. On certain projects it has been necessary to recommend the installation, over vital areas, of an inverted catenary system crossing the panels diagonally and anchored to the footings, to provide snubbing action.

In many cases it has been advisable to attach the cables to the buildings. Where possible, cable pulls are balanced on each side of a building. In all cases the buildings are analyzed to check their resistance to these pulls. It may not be advisable to make attachments to buildings unless all the cables on one side can be cut without endangering the safety of the building. Sometimes buildings are strengthened with this possibility in mind. At other times slip joints are provided so that the cables can be run over or through the buildings.

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

A Simplified Solution for Equivalent Pipes

By QUINTIN B. GRAVES, ASSOC. M. AM. SOC. C.E.
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In solving distribution-system problems by a modification of the method developed by Hardy Cross, it has been found desirable to use the Manning formula for flow. This formula may be reduced to the form:

$$H = KQ^2 \quad \ldots \quad (1)$$

in which $$K = \frac{23{,}100\, n^2 L}{d^{16/3}} \quad \ldots \quad (2)$$

H = head lost, in ft
Q = rate of flow, in thousands of gal per min
L = length of pipe, in thousands of ft
d = diameter of pipe, in ft
n = roughness coefficient

Values of K per 1,000 ft of pipe can then be obtained from Table I. Taking the proper value of K from this table for given values of n, D, L, and Q, the loss of head can easily be computed. For pipe-flow problems it has been found that the substitution of equivalent pipe for certain combinations of pipes in the system will prove very useful. For pipes in series, the values of K for the several sections are determined individually and then simply added together arithmetically to obtain the equivalent value of K for the series.

TABLE I. VALUES OF K PER 1,000 FT OF PIPE

D, in.	n = 0.010	0.012	0.014	0.016	0.018	0.020
4 in.	815.0	1,170	1,600	2,090	2,640	3,260
6 in.	93.3	134.0	183.0	239.0	307.0	373.0
8 in.	20.1	29.0	39.5	51.5	65.2	80.5
10 in.	6.12	8.84	12.0	15.7	19.8	24.5
12 in.	2.31	3.34	4.54	5.92	7.50	9.25
14 in.	1.01	1.46	1.99	2.60	3.28	4.05
16 in.	0.501	0.720	0.983	1.28	1.62	2.01
18 in.	0.267	0.384	0.521	0.680	0.864	1.07
20 in.	0.151	0.213	0.297	0.388	0.490	0.606
24 in.	0.0576	0.0829	0.113	0.148	0.187	0.230
30 in.	0.0175	0.0252	0.0343	0.0448	0.0566	0.0700
36 in.	0.00660	0.00953	0.0130	0.0169	0.0214	0.0264

The writer has not seen elsewhere the following solution for the equivalent of pipes in parallel. If any number of pipes in parallel (Fig. 1) are considered, the following analysis can be made for pipes of various lengths and sizes. In such a circuit,

$$Q = Q_1 + Q_2 + Q_3 + \ldots + Q_n \quad \ldots \quad (3)$$

Here Q is the total rate of flow through the system, and Q_1, Q_2, etc., are the flows in the branches of this system. If H is the head lost from A to B then,

$$H = K_1Q_1^2 = K_2Q_2^2 = \ldots = K_nQ_n^2 \quad \ldots \quad (4)$$

and

$$Q_1 = \frac{\sqrt{H}}{\sqrt{K_1}};\ Q_2 = \frac{\sqrt{H}}{\sqrt{K_2}};\ Q_n = \frac{\sqrt{H}}{\sqrt{K_n}} \quad \ldots \quad (5)$$

Substituting Eq. 5 in Eq. 3,

$$Q = \frac{\sqrt{H}}{\sqrt{K_1}} + \frac{\sqrt{H}}{\sqrt{K_2}} + \ldots + \frac{\sqrt{H}}{\sqrt{K_n}} \quad \ldots \quad (6)$$

From Eq. 6,

$$Q = \sqrt{H} \times \left(\Sigma \frac{1}{\sqrt{K}}\right) \quad \ldots \quad (7)$$

and

$$H = \left(\frac{1}{\Sigma \frac{1}{\sqrt{K}}}\right)^2 Q^2 \quad \ldots \quad (8)$$

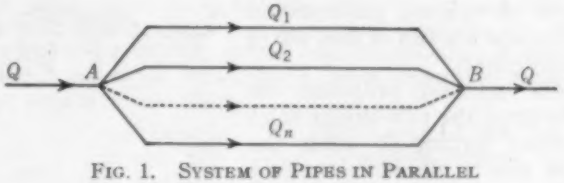

FIG. 1. SYSTEM OF PIPES IN PARALLEL

But the value for the equivalent single pipe (K_e) is

$$H = K_e \times Q^2 \quad \ldots\ldots\ldots (9)$$

Hence

$$K_e = \left(\frac{1}{\Sigma \frac{1}{\sqrt{K}}}\right)^2 \quad \ldots\ldots\ldots (10)$$

With this equivalent value of K, the head loss, H, from A to B can easily be determined for any value of the total rate of flow, Q. If it is desired to obtain the distribution of flow through the system of parallel pipes, the flow in each can then be computed from the head loss, H, corresponding to the total rate of flow Q by solving Eq. 4 for Q_n.

Sludge-Digestion Tank Entered to Make Pipe Repairs

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OPERATORS of sewage treatment plants have always considered the removal of the contents of a sludge digestion tank to make necessary repairs a task to avoid. At least such was the feeling at the Sewage Treatment Plant at Buffalo, N.Y., where for several years an effort was made to keep raw-sludge feed lines clear of scum incrustation by means of steaming, rodding, and other methods, without attempting to correct the real cause of the trouble. However, these exterior methods of approach were not satisfactory and the result was that sludge loading into the four digestion tanks could not be equalized. With the enormous increase in scum-producing solids, resulting chiefly from augmented industrial activity, it became imperative to improve the operation of the digestion system of the treatment plant.

GAS DOME PROVIDED ACCESS TO TANK
Fresh Air Was Drawn in Through Vent Pipe

This system consists of four concrete sludge digestion tanks, surrounding a central control station. The tanks (Fig. 1) are 90 ft in diameter; the cylindrical section is 28 ft deep, and below is a conical section 11 ft 3 in. deep. Each tank is equipped with a floating cover, raw-sludge feed, and digested-sludge withdrawal lines, supernatant withdrawal lines at three elevations, gas-removal lines, and a series of hot-water heating coils.

The method proposed for relocating the raw-sludge inlet without having to enter the tank was to eliminate the flow from two long branch lines by lowering the sludge level so that the line outside the tank could be opened and a break made through the T-connection within the tank to form a new point of discharge. This plan was not entirely desirable because discharge nearer the center of the tank would be more advantageous, and other contemplated piping changes within the tank could not be made. However, it was given consideration because the complete removal of sludge, which ranged from 2 to 24.9% dry solids and averaged about 65% volatile matter, would not be required.

Discovery of broken circumferential heating lines in the tank completely altered this plan, as it meant that most of the tank contents had to be removed to permit entrance and to uncover the lines for repair. Much of the scum, softened with water and steam, was pumped with the sludge to the other digesters. The interior of the tank was thoroughly ventilated and when it became apparent that no harmful gases were present, entrance to the interior of the tank was made through the gas dome. The scum remaining in the tank, averaging about 28% solids, proved to be stiff enough to support the planks working platforms on its surface.

Examination of the tank interior showed a solid mat of scum over the entire area. Much of this was dried and cracked, and appeared as sludge does on a drying bed. There were many large lumps of pure grease, and under the point of discharge of each raw sludge inlet line were piles of accumulated sand.

The 4-in. cast-iron gas pipe within the tank was replaced by a 6-in. cast-iron line. This change, now possible, was necessary because friction losses within the 4-in. line prevented full utilization, or safe wasting, of the gas. These lines normally would deliver up to about 600,000 cu ft per day, and the peak production often exceeded 1,400,000 cu ft per day from the four tanks.

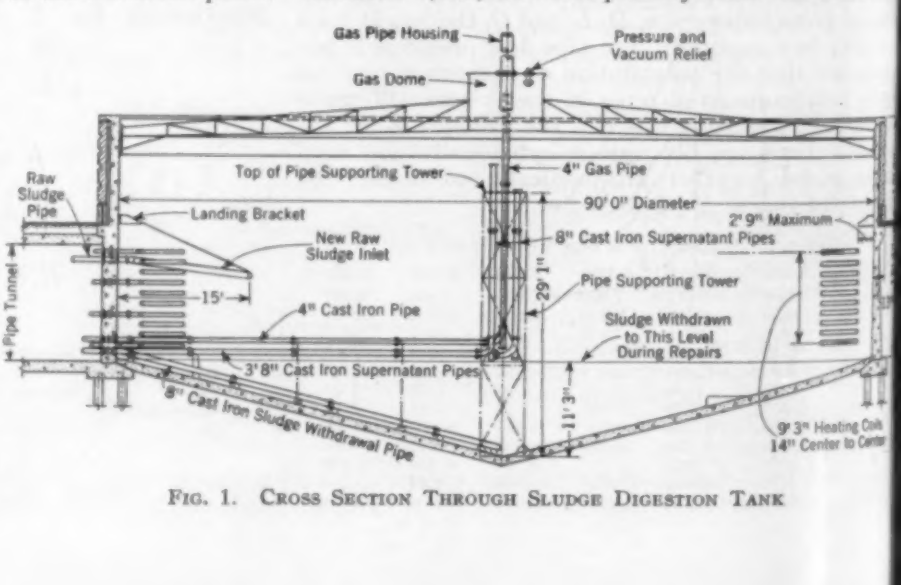


FIG. 1. CROSS SECTION THROUGH SLUDGE DIGESTION TANK

This meant that excess gas had been vented at the tank-cover relief valves in such quantities as to be hazardous.

When the two 8-in. cast-iron branches of the raw sludge line were dismantled, they were found to be badly choked with sludge and scum. One of the lines had not been functioning for some time, as its entire length was solidly plugged. For ease in future cleaning, the T-connection was eliminated and the new raw-sludge line was carried out from the wall inlet, on a slightly oblique angle, to a point 15 ft toward the center of the tank. Installing the point of discharge at a greater height above the sloping tank floor will prevent recurrence of the accumulation of inorganic materials. The support for the recording thermometer (the end of which projects into the tank for proper temperature control), having failed, was completely rebuilt. The lead cable carrying the control wires from the thermometer was placed in a non-corrosive metal pipe and supported on a structural-steel framework.

The heating coils, consisting of 3-in., cast-iron, threaded-joint pipe, were restored in two ways. The bottom coils were repaired with nipples and couplings, and swing joints were installed to provide for pipe expansion. Because of the great number of breaks in the top coil, extensive repairs were made by electric welding. Some welds were made the entire length of a 20-ft pipe section, and many lengths had vertical as well as horizontal splits. Where a hole was encountered, the line was cut and a short nipple was welded in place.

Approximately five months elapsed from the beginning of sludge removal from this digester until the tank was finally closed and ready for service. The hardened scum remaining within presented a problem, for further removal was impossible without breaking additional openings into the tank for hand or machine loading into trucks. There was also a lack of disposal facilities, so the only alternative was to expect that the addition of good seed sludge would break down the material. To renew the digestion process, sludge was withdrawn from the remaining tanks and fed into the repaired digester for short periods until gas production began in some quantity. Volatile acids were maintained at about 600 ppm. Thereafter small doses of raw sludge were sent to the tank for a period of serveral days, after which the regular cycle of feeding and withdrawal was resumed. This cycle has continued uninterruptedly with the exception of one short rest period, required when the top material began to foam.

Repairs to the tank have apparently been very successful. Sludge withdrawn from this tank has been well digested. The entire scum mass, which had lain on the tank bottom during repairs, when mixed with seed and raw sludge underwent rapid digestion and was easily withdrawn for burning. A definite improvement has been noted in the depth and dry solids content of the scum.

BREAKS IN HEATING COILS WERE WELDED
New Raw Sludge Inlet Shown Overhead

The volume of gas drawn from this tank has been tripled, and it is now possible to divert raw sludge flows of 200,000 gal per day to it, where formerly it was often difficult to distribute flows over 150,000 gal, even with the lines to all four digesters open. The cleaning of the line from the control box into the tank can now be accomplished with ordinary equipment.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

The Pan-American Highway Not Accurately Described

TO THE EDITOR: Colonel Kelton's article on the Pan-American Highway, in the November issue, contains certain statements that may be misleading. It is stated that transportation in Mexico and Central America has "passed from the ox-cart stage to that of the airplane without passing through railroad or highway stages." All the countries, except Honduras, have been effectively served by railways and many by highways for many years—Costa Rica, for instance, for over 50 years, and the others nearly as long.

The writer of the article stresses the fact that the "natives" have been friendly. Why wouldn't they be when we are spending a lot of our money in their countries? They may, however, resent being referred to as "natives."

The value of any 16-ft highway may be questioned, especially a gravel-surfaced highway in the tropics, which is not at all likely to be maintained unless the United States does it. Having known Guatemala very well for over 30 years, I was quite surprised at the statement that parts of it, at elevations of 10,000 ft and more, were almost continuously shrouded in fog. That is a phenomenon I had not noticed. The economic or commercial value of the route is nil. There is no commerce between the various countries, nor is there likely to be any. The value of a through route to Panama for military purposes is doubtful or entirely non-existent. The highway can have no value in "cementing a great friendship with the United States." We have never been unfriendly and we have long had friendly relations both commercially and diplomatically.

One notes with regret the omission of credit to E. W. James, of the Public Roads Administration, who has done a great deal of arduous, faithful pioneer work for many years in surveying and developing the route.

It might be suspected that the use of "English" measures was due to inertia or sales resistance or something other than the fact that "instruments," tapes, and level rods were not available. One also must deplore the wasted manpower, especially the trained technical men employed, and the tools, machinery, and materials, manufactured in the United States, when we have so much need of all these in the war effort.

FRED LAVIS, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.

"Spot Cost" Method Effective in Control of Labor Cost

TO THE EDITOR: Labor management control through up-to-date unit labor cost keeping is, as Mr. Brigham has stated in his article in the November issue, a prime function of good management. However, most unit labor costs on the large wartime construction jobs known to the writer were so far in excess of the unit labor costs on normal construction jobs that they were a distinct shock to engineers and contractors accustomed to large peacetime operations. The conditions under which these costs occur are such as to make the results of cost keeping of little use for future peacetime construction jobs. Cost accounting, as customarily conducted on large government construction projects, is worth while chiefly for its accounting record of the entire project. The control and reduction of costs must be secured by other methods.

In the writer's experience, unit labor cost keeping on large construction jobs is largely ineffective for management purposes during the life of the construction operation when the cost keeping is done by accountants under the customary rigid accounting methods. Reasonably reliable unit costs are seldom made available from accounting "systems" until some time after the construction work is completed. Tentative costs relating to some portion or phase of the job may be available from 30 to 60 days or more after the completion of that part of the operation, but seldom in time to be of much practical use. Furthermore, such tentative accounting unit costs frequently are found later to be so far from actual final costs that use of them would have been very misleading.

The "spot cost" method, recommended by Mr. Brigham, is undoubtedly one of the best methods of labor-cost control. The example shown in Fig. 2 would seem to be of little value on a large job because it was confined to only 12 cu yd of concrete placed by a crew of seven men, but the same method can be applied to larger operations. The writer recommends for this purpose that material costs be eliminated and the spot check confined to labor cost only, since the cost of materials is chiefly controlled by design. By eliminating material costs, spot cost checking is greatly facilitated and more readily concentrated on the important phases of the work. Separate checks can be made on vital material costs. For example, the unit cost of forms for concrete cannot be promptly determined on one section of a large construction job, because of the re-use of materials on several sections or buildings, but the unit labor cost can be quickly ascertained by a field inspection and "spot" check.

One superintendent on a large wartime construction job who could get no satisfactory results from the accounting system resorted to the spot labor cost method quite successfully. He placed several young engineers on certain important labor operations to check items of work over a specified period. These young men reported the unit labor hours and unit labor costs at the end of that period, or weekly if the particular operation being checked extended over a longer time. In this way the actual labor costs were available immediately for certain important operations without waiting for book-keeping delays necessary in order to prorate material costs, include overhead costs, plant charges, and insurance, all of which are of course necessary in the detailed cost accounting of the entire job but which are useless in determining the efficiency and output of labor.

The writer has been greatly impressed with the futility of detailed unit cost keeping and similar activities on our large wartime construction projects. On many of these projects there has been much ado about so-called management based on cost accounting and on extensive use of statistics, schedules, charts, curves, graphs, and what not, under conditions which caused much of such work to be of little practical value. For example, contractors have frequently been required to prepare in advance and to revise and maintain during construction elaborate schedules and progress charts of construction operations costing millions of dollars, for which no plans and specifications were available, it being necessary to develop the plans as the construction progressed. In such cases a successful "schedule" depends largely on the imagination of the contractor and the engineers and architects who attempt to prepare it. Much of such work actually serves no essential purpose during construction of the project and, for all practical purposes, is utterly wasted. Perhaps it is rank heresy to say so, because such work has certainly employed a very large number of engineers. True engineers, however, get little satisfaction out of non-essential work. However, it surely is not the writer's intention to advocate the abandonment of construction management by the methods described in Mr. Brigham's articles and in this comment, but rather to recommend that such management be confined to and extended along practical lines.

HENRY H. JEWELL, M. Am. Soc. C.E.

Chevy Chase, Md.

Early Method of Laying Out Curves

DEAR SIR: I recently encountered an article of early date, a matter of fact prior to the construction of any steam railroads which described a scheme for laying out or string-lining curves. I found this in "Observations sur la construction, l'entretien et l'amelioration des chemins notamment de ceux de traverse," dedicated to the "cultivateurs de l'helvetie," by J. S. Guisan (A Berne, de l'Imprimerie Nationale, 1800). A translation of the description follows:

"If it is a question of tracing a curve as *PDF* (Plate 1) stakes are placed an equal distance apart such as 6 or 8 ft, 6 or 8 fathoms

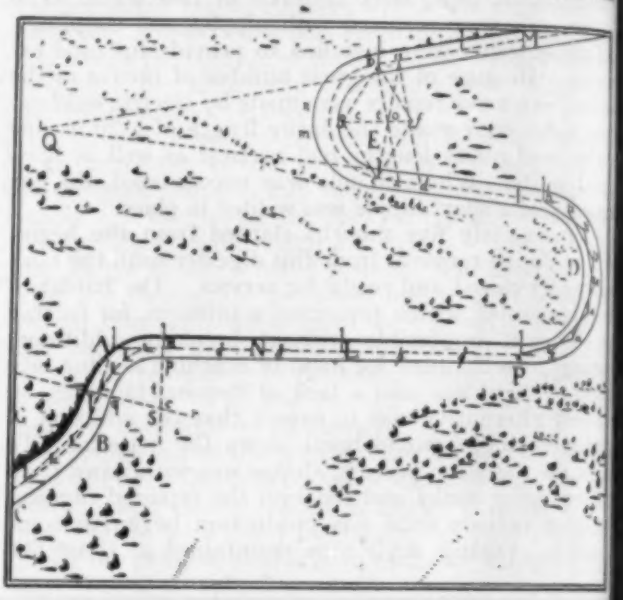


FIG. 1. METHOD OF TRACING CURVE ADVOCATED BY GUISAN IN 1800

according to the extent of the curve to be made. Then two lines are strung, the one passing through every other stake as *hdmf*, and the other also passing through every other one, but crossing the first, passing by 2, 3, 4, 5. This operation will show at once which of these stakes are too far in or too far out, to make a regular curve. They are advanced or drawn back until the triangles formed by the lines are about equal, and in this manner the regularity of the outline is assured. It is understood that if the curve is very large, lines can no longer be used, and it is necessary then to substitute sighting."

The plate referred to is reproduced here as Fig. 1.

JOHN S. WORLEY, M. Am. Soc. C.E.
Curator and Chairman, Transportation Library, University of Michigan

Ann Arbor, Mich.

Society Members Honored by Chinese Government

TO THE EDITOR: Purely as a matter of keeping the Society records of our membership accurate, I should like to correct the enclosed statement in the December issue to the effect that Harry A. Raider is the first engineer to receive a medal of honor from the Ministry of Communications of China.

The Ministry of Communications decorated me (Order of the Bountiful Harvest) in 1917 when I completed the survey from I-Chang in Hupeh Province, via the Yangtze River Gorges, to Chungking and thence across the Red Basin of Szechuen to the provincial capital of Szechuen at Cheng Tu—a total of 731 miles. This decoration awarded me in 1917 was therefore the first awarded to an American engineer, although two Chinese members of the Society—K. Y. Kwong and Dr. Jeme Tien Yow—were similarly honored, as were two British engineers. So far as I am aware, we six men are the complete list of engineers who have received this recognition from the Chinese government.

The decoration itself, I think, can be best described as an eight-pointed star with a circular disk in the center. On one side are Chinese characters, and on the other what seem to be five heads of wheat, the whole suspended from a red silk ribbon edged in white. A red and white rosette and a citation (in Chinese) about the size of a college diploma accompanied the decoration.

This letter is not in any sense a criticism of Harry Raider, who served under me as resident engineer of Section 10, on the Kwang-tung Yueh Han Railroad from 1909 to 1912, and as one of my division engineers on the Szechuen Survey from 1913 to sometime in the autumn of 1917, when we were ordered to close down the job because of the first World War and lack of funds to accomplish the construction of the road. He probably does not know that I was decorated; I never mentioned it to my staff, and never thought to mention it in any such connection as this.

RICHARD WOOD RANDOLPH, M. Am. Soc. C.E.
Atlantic City, N.J.

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

Herewith Dr. Mead gives his answer to Problem No. 17 which was announced in the December issue of "Civil Engineering." The problem reads: "Assume, as an engineer, you have spent some years in contracting, have practically retired from that business, have established an office in a large city, and have begun practice as a consulting engineer. You have been employed by a small city to design a sewer system. You have estimated the cost of the system at $62,000, including a discount of $4,000 on the special assessment script which is to be issued in payment for the work. This discount has been quoted to you by a banker who has been buying and selling such securities.

"The Mayor says to you: 'You have had experience in contracting. Why don't you take this work at your own estimate? We have confidence in your ability to do a good job, and we know your estimate was made without any knowledge that you might be asked to do the work; it is therefore fair.' (You are to assume that at the time the question was asked you, the letting of this contract to you by unanimous vote of the city council would be a perfectly legal matter.)

"You answer: 'If you can get someone else to take my place as your engineer, and I can arrange to finance the work, I might be interested in taking this contract at my estimate.' You then see the banker who has agreed to take the paper at the discount named, and he agrees to see the city officials and inquire concerning their time of issue and validity.

"A few days later, the banker sends for you and says: 'We have decided to take this paper but will have to charge you a larger discount. You know the mayor and the city council do not get paid for all the extra work involved by this contract, and I believe that you will agree they should have some consideration. We have arranged for you to get the contract for $68,000 and will charge you a discount of $10,000. This will leave you whole and will make it possible for me to take care of the mayor and council without cutting into your profit. We will take care of all the arrangements so that you will not need to give it another thought.'

"Do you feel certain or doubtful as to your answer to the banker? What would your answer be, and why?"

This problem was propounded not because the writer did not realize that practically all engineers of any experience would not at once recognize that the scheme suggested was not only unethical but rankly dishonest and criminal, but it was offered as an illustration of about the worst scheme in principle that has been put up to the writer during his entire experience.

It is undoubtedly true that a considerable number of such schemes, involving many times the amount of that in the case mentioned, have been carried out successfully in some of our larger cities although, fortunately, some of the participants in such schemes were discovered, taken into court, and are now living in the prisons of our country at government expense.

The representative of the bond house who was considering the purchase of these securities, after interviewing the mayor and city council, called in the writer and told him that the mayor and council had confidence in the writer's ability to carry out the contract satisfactorily and were willing and anxious to let him undertake the work. He stated, however, that the mayor and council had considerable extra work to perform in connection with the contract and that he believed the writer would agree that they were entitled to some extra compensation. He further said that they would let the contract to the writer on the contract price of $68,000 but that the bond house would charge the writer $10,000 discount on the bonds which, however, would still leave the writer with his original contract cash price of $58,000. The representative added that otherwise the writer would have nothing to do as the bond house would take care of the mayor and council.

The writer replied with the statement that the mayor and city council apparently had so much confidence in him that they wanted him to help rob the city. The representative asked if that was not a pretty rough way to put it, and added that his firm found it necessary to handle these municipal matters very frequently in the way he suggested.

The man in question was always an enigma to the writer. He was, or had been, an active member of the church, a Sunday school teacher, and a very active member of the Y.M.C.A., and his previous record as a business man was exceedingly good. The writer responded that he had always done his work honestly and that he was too old to learn any other method. The bond dealer protested that the writer was knocking him out of a very profitable arrangement. The writer then told him that he (the bond dealer) should advise the mayor that while the writer refused to enter into such an agreement, it would not be necessary for the mayor to continue his employment as he had already been paid for the plans submitted. However, he added that if the work was not let at essentially his (the writer's) estimate and done properly, he would feel it was necessary to take the matter up with a former mayor of the city who, he felt, would be glad to straigthen out any crookedness through the courts. The writer was later approached unsuccessfully by another representative of the mayor, after which they gave up the attempt and the work was not done at that time.

About two years later, three men came to the writer's office, one introducing himself as the recently elected mayor of the city and the other two as members of the committee on public works. The mayor recalled to the writer the fact that he (the writer) had prepared plans for the city two years previously, and remarked that while the writer was down there "there was a job on." The writer, indicating a surprise which he did not feel, asked if that was so, and the mayor smiled and said: "Well, now you know all about it. We thought that you were in the scheme until recently when we learned you killed the whole proposition. Now," he added, "we want you to come down, let the contract, and supervise the work." This was carried out, and later the writer did considerable other municipal work for that city.

The writer believes that, fortunately, there are few engineers so anxious for money that they would go into a scheme of this kind, but of the fact that there are some there can be no doubt. In the writer's opinion self-respect is one of the most important attributes for the happiness of any honest individual.

DANIEL W. MEAD, Past-President
and Hon. M. Am Soc. C.E.
Madison, Wis.

Problem No. 18, as given in the January number, will be answered in the next, or March, issue. Replies for the following problem may be received until March 5, with answers in the April issue.

PROBLEM NO. 19: *A consulting engineer is employed by a municipality to examine into the safety of the design of a municipal structure which is to be built from plans of another consulting engineering firm. During his examination it becomes quite clear that the construction cost will be high, that the annual operating expense including maintenance and depreciation will be exorbitant, and that there will be a large waste of public funds. What obligation, if any, does the consulting engineer have in the matter of reporting this to the municipal authorities?*

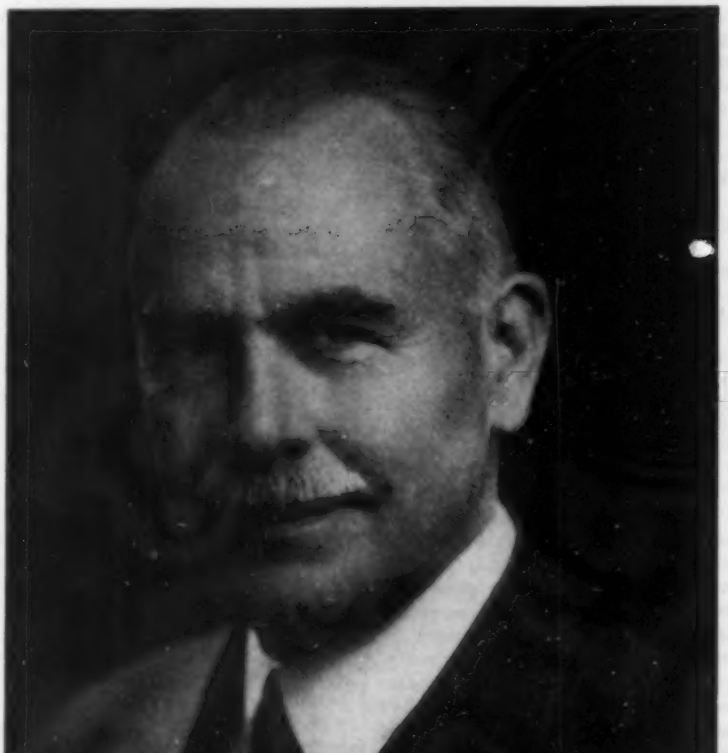
SOCIETY AFFAIRS

Official and Semi-Official

Malcolm Pirnie, President for 1944

AGAIN, in a critical year, the Society turns to a relatively young man for its leadership. He may be young in years, young in appearance, and young in manners, but he is not young in experience, or in Society affairs. His success in the profession and in the organization over many years of activity is the background and the cause of his present elevation to greater leadership.

So far as experience is concerned, the story can be quickly told. This is because Malcolm Pirnie has obtained a breadth of engineering work with a minimum of affiliations. Following his graduation from Harvard in 1910, with a master's degree in 1911, he has been connected with only two engineering offices. For just about half the time, or until 1929, he was associated with Allen Hazen—in the firms of Hazen and Whipple; Hazen, Whipple and Fuller; and Hazen, Everett, and Pirnie. Since that date he has been head of his own firm. Inserted in this consulting work were two duties connected with World War I. In 1917 he went as assistant sanitary engineer with the Red Cross mission to Russia. Following this, in 1918 and 1919, he was assistant engineer of water supply for the Engineer of Construction, Headquarters, Director General of Transportation, A.E.F., with rank of Captain, Transportation Corps.



MALCOLM PIRNIE

A review of his early partners will indicate to anyone familiar with sanitary work that he benefited by good associations. Men like Allen Hazen, George Whipple, Weston Fuller, and Chester Everett made reputations for themselves, to which Pirnie as junior partner was later to add his own share.

Looking backward, it appears that no engineer starting his own business in 1929 would be expected to have had an easy time. Certainly, the period immediately following was not auspicious for the development of a consulting engineering business. The fact that Mr. Pirnie has been successful, and notably so, is a measure of the caliber of the man. His experience in water supply and sanitary work has expanded its scope over the three decades. At first largely along the Eastern seaboard, it has spread in latter years to cover the whole country, from Maine to Florida and to California.

Since 1940 his firm has addressed itself almost exclusively to Army and Navy work, and defense projects. It served as partner of the Architect-Engineer association on the huge U.S. Naval Training Station project in Sampson, N.Y., laying out water and sewerage works as well as incineration facilities. It has been responsible for engineering features at many service camps in California. As consultant to the Architect-Engineer group, it similarly served the Scioto Ordnance Plant in Ohio, for which it received jointly with others one of the earliest Army-Navy "E" awards.

The firm is particularly well known in the Caribbean area. Its current work on the greatly needed additional water supply project to serve San Juan, Puerto Rico, is notable. Similar work was done in Jamaica, as well as extensive consulting service in Trinidad and Venezuela. Mr. Pirnie holds engineering licenses in many states, and Puerto Rico. Recently the President of the Institute of Engineers of Puerto Rico appointed him a member of the "Committee of Pan-American Relations of the Puerto Rican Engineer."

He has found time to serve as consultant to the War Department; to be a member of the Engineering Board for the Atlantic Gulf Ship Canal; to act as deputy administrator, NRA, and member of the Technical Board of Review, PWA; to work as consultant to the commanding generals of the Quartermaster Corps and Army Service Forces; and to serve on numerous other professional, public, or welfare committees and boards.

All this sounds like too much of an assignment for one person. The answer is that Mr. Pirnie is naturally thorough and hard working. In fact, it is recorded that once he was arrested in Virginia, a victim of some "blue law," for working on Sunday. And that was not the only Sunday he has worked. Another fine trait is his optimism. Doubtless this stood him in good stead during the depression. To his associates it sometimes seems that his rosy expectations are like pipe dreams; but the wonderful part of it is that most of his dreams come true. Certainly his firm has been very fortunate in receiving a large number of important assignments.

Like many another prominent engineer, his success has not come the easy way. He is persevering and determined. His keen analytical mind is quick to size up the fundamentals of a situation. Then he is equally diligent in developing the details. His associates find him generous to a fault—not merely in financial matters but in giving credit and in providing opportunities. He puts the members of his staff on their own and then recognizes their worth. In thus developing a strong esprit de corps, his aim is to have a good organization rather than to enjoy a purely personal success, or in the vernacular, to develop a good team rather than a few stars. Like many another organization, the Pirnie firm has felt the temptation toward grandeur, toward a broadened scope, and a multiplication of services rendered. But throughout the war effort he has resisted this temptation; he has stuck to his own field, and the results have been gratifying.

To whatever Malcolm Pirnie gives his name or his membership, he does it with wholeheartedness, with enthusiasm. And this loyalty has been recognized in a multitude of honors. He has been president of the American Water Works Association and is chair-

man of its important Water Works Practice Committee. Likewise he has been president of the Institute of Consulting Engineers. A Junior member of the Society in 1914, he has supported it in every way, has served on important and time-consuming committees, and in the Metropolitan Section has held many of the offices, including president. In the national organization he has served terms as Director and Vice-President.

In his home town of Scarsdale, N.Y., noted for its good government, he has held various offices, including that of mayor. He has been a trustee of Vassar College, and is at present a member of the Advisory Council to the Civil Engineering Department of Princeton University. For years he has been actively interested in the White Plains, N.Y., Hospital; he was on the Building Committee when it made its recent extension. His friends thought that also he must have supported the hospital for many months, because of family sickness. Happily, Mrs. Pirnie is now recovered from a persistent illness and as a result many Society members and their wives will have the opportunity during the year of knowing her and enjoying her radiant personality.

To those who meet him, Mr. Pirnie shows a genial temperament. He is the delightful companion, the perfect gentleman. Although not the "glad-hand" type, he is nevertheless sociable. Much of his success can be attributed to his ability to get along with people, surely a fine attribute for the leader of the Society.

Essentially a home man, Mr. Pirnie is devoted to his family—this in spite of the fact that his business activities have taken him away so much. He likes to have them with him on trips, and some if not all of his children have been with him at Society meetings. On some of these trips he has indulged his hobby of photography. His colored movies taken on the trip to the Salt Lake City Meeting in 1938 are very fine. His son and namesake, now wearing a Captain's uniform in the U.S.P.H.S. and a Junior in the Society, is a graduate of Harvard, while the elder of his daughters is a graduate of Vassar and the younger one is about to graduate. Thus all the children have maintained the family educational traditions.

His professional, civic, and business activities have left Mr. Pirnie little time for athletics or amusements. He enjoys sailing and sightseeing, although travel has long since ceased to be a novelty to him. In connection with his frequent professional visits to Florida, he has taken some time for deep-sea fishing, and has returned with better than the usual spoils, duly authenticated by certificates that his friends try to infer are "phony."

Many members will look forward to the opportunity of meeting Malcolm Pirnie during his term as President. In his personal relationships they will find him genial and hearty; in his Society relationships, sincere and loyal; and in his public relationships, dignified and urbane. He has the qualities that make for successful leadership and it is these qualities that have logically brought him this honor. The Presidency of the Society is in good hands for 1944.

The Ninety-First Year

Progress Noted in Annual Report of the Board of Direction, Here Abstracted

THE YEAR 1943 has brought many changes in the activities of the Society and of its members. Construction for war purposes has decreased from its high pitch of intensity. Many members have entered the service of the federal government as civilians in the newly created, or enlarged, agencies furthering the war effort. It appears probable that as many as 4,500, or it may be 5,000, Society members are in the Armed Services. In consequence it must be admitted that the technical work of the Society has had to be laid aside in considerable degree. However, the Society has continued its growth, improved its financial condition, and entered into new activities with zest.

HELPING TO WIN THE WAR

In the past three years the Society has been looked to as a source of men especially fitted for work essential to the war effort, although not necessarily on war construction. Early in the year sanitary engineers were wanted in large quantity to go to South America or overseas. The Corps of Engineers recruited its Engineer Regiments, and the Navy its Construction Battalions (Seabees), and utilized the Society's publications to make their desires known. The biographical records of Society members, filed at Headquarters, have been searched again and again for men with special attainments. Telephone calls innumerable, to Society Headquarters, have defined the need for specialists of one type or another, and in each instance an effort has been made to render as great help as possible. Although there is no way of knowing precisely how many members of the Society are working directly on some phase of the war effort, it is certain that only relatively few are not so engaged.

HELPING TO WIN THE PEACE

In July the Board of Direction adopted the report of its Committee on Postwar Construction, devoted essentially to the value of public works as a medium for alleviating unemployment when the war ends. Twenty-five thousand copies of the report have been printed and distributed to members of the Congress and other federal officials, to governors, mayors, city engineers, city managers, state highway engineers, and the members of state legislatures, accompanied, in many cases, by individual letters requesting attention and action. Local committees on postwar construction have been established in 20 of the Society's Local Sections, with personnel aggregating more than 165. Many of these are members of official planning commissions and others are being called upon by officials for suggestions and advice. Although the words "postwar" and "planning" are widely used today, many think of "postwar planning" merely in terms of the listing of projects to be undertaken. Planning of construction work, as engineers understand it, goes further than that, and it is such real planning that the report urges be done now.

THE ECONOMIC WELFARE OF CIVIL ENGINEERS

To a greater degree than usual, the Board has felt concern this year over the economic welfare of civil engineers. A year ago unemployment of considerable extent seemed impending. To what degree civil engineers, released from war construction, or unemployed because of priority restrictions on normal work, would find reemployment in industry was a question. In general, however, it now appears that civil engineers of any real degree of training and experience, except some with only field experience, have found reemployment for themselves, not so much in industry as in the federal agencies related to the war effort. Many others are in the Armed Services.

A year ago those engineers who had contracts with the government for the design and supervision of construction of war projects were alarmed by the federal legislative provisions regarding the renegotiation of those contracts whereby what might be deemed "excess" profits might be taken away. Throughout the year the President of the Society and a committee appointed by the Board have continued to deal with officials in the War Department to attempt to secure uniform treatment in the renegotiation of contracts for professional services, and at least a statement of the basis, or bases, on which "excess" profits were to be determined.

With relation to employed engineers, the Board has been conscious since 1937 of the efforts of unions affiliated with organized labor to enroll sub-professional and professional engineers in its ranks. In that year a committee established by the Board made inquiry as to the degree to which that situation obtained. The Committee's Report recommended that the Society take steps to provide for a grouping of engineers through which, by representatives of their own choosing, engineers could seek to remedy unsatisfactory employer-employee conditions.

Quarterly reports to the Board of the situations found, and the efforts made to remedy conditions, have given the members of the Board a consciousness of what is going on with respect to the unionization of engineers. It was out of knowledge of these experiences, some of which have been communicated to the membership through the medium of CIVIL ENGINEERING, that at its October meeting the Board voted to recommend to the Local Sections that they amend their constitutions, according to the Society's prescribed procedure, to provide for the formation of

collective bargaining groups of professionally minded engineering employees in their respective areas, and drafted a definition of "Professional Engineering Employees."

PUBLICATIONS

Maintenance of the high standard of the Society's publications has been difficult this past year. Censorship of what might be printed, particularly in the early part of the year, prevented the publication of many articles descriptive of new procedures in construction projects, the use of new materials, and the application of new methods of design. This censorship applied also to matters that might be discussed at meetings, which provide the source of many articles excellent for publication.

The requirement that the Society's use of paper be reduced by 10% from that used in 1942, combined with an increase in membership entitled to receive those publications, called for several adjustments, some in the way of reduction of text, others in decreased complimentary copies and, beginning with the July issue, in a reduced over-all size of CIVIL ENGINEERING. The concentration of members of technical committees upon their individual participation in the war effort, too, has led to fewer published reports or manuals. The membership of the Society has responded so generously to curtailments deemed necessary that it can be reported with satisfaction that the 10% reduction required has been complied with, within four-tenths of 1%.

MEMBERSHIP AND FINANCES

It is with a feeling of real satisfaction that this portion of this report concludes with happy comment upon the Society's membership growth and sound financial condition.

Membership on December 31 again reached an all-time high, at 19,430, a net increase of 1,076 during the year. The gain of 1,576 by election, readmission, and reinstatement is accounted for largely by the 944 students and young men who became Juniors. Juniors, who nearly equal the number in the Member grade, now constitute a little over 30% of the entire membership.

Again the Society has conducted its affairs within its income. Initiation fees exceed those of last year but the dues collected have been slightly less because of the fact that so many in the lower ranks of the Armed Services, or otherwise restricted from communication with the Society, have been granted cancellation of their 1942 or 1943 dues, or have been placed on an "Inactive List," with dues canceled and unbilled, until contact with them can be reestablished.

Cancellation of dues has been granted to 633 members in the Armed Services and to 299 members whose names are carried on the "Inactive List." One hundred and seventy-eight members became Life Members at the end of the year.

The sound financial condition of the Society can be attributed chiefly to the income received from dues, from the rental of the 57th Street property, and from the advertising in CIVIL ENGINEERING. Total income received during the year, and thus available for the various operations of the Society, was in the ratio of $1.70 to each $1.00 collected as dues.

MEMBERSHIP OF TECHNICAL DIVISIONS

City Planning	818
Construction	4,474
Engineering Economics	1,023
Highway	2,004
Hydraulics	2,472
Irrigation	659
Power	852
Sanitary Engineering	1,609
Soil Mechanics and Foundations	2,171
Structural	3,755
Surveying and Mapping	1,438
Waterways	857
Total	22,132

STUDENT CHAPTERS

During the year two new Chapters were chartered—making a total of 123. The new Chapters are at the University of Notre Dame, Notre Dame, Ind., and the University of Toledo, Toledo, Ohio.

New York Is Host to the Annual Meeting

DESPITE the inconveniences of travel and the press of business at home, more than 1,700 members from all sections of the country attended the Society's Annual Meeting in New York. For three days, January 19–21, the Engineering Societies Building hummed with activity connected with the business and technical sessions. Evenings were all too short for the multitude of social gatherings which brought old friends together again, not to mention the many new friendships formed.

On Wednesday morning the formal opening session centered about the presentation of honors and prizes. Certificates of Honorary Membership were conferred upon Edward H. Connor, Francis T. Crowe, Gerard H. Matthes, and Thomas H. MacDonald. Also at this time nine prizes were awarded.

The Norman Medal was placed in the hands of Thomas E. Stanton, who come all the way from California. Carl H. Gronquist of New York was the recipient of the J. James R. Croes Medal. For his paper on the San Gabriel Dam No. 1, Paul Baumann received the Thomas Fitch Rowland Prize. The James Laurie Prize went to Thomas A. Middlebrooks of Washington, D.C., while the Arthur M. Wellington Prize was won by Milton Harris, a major in the Army, now stationed in Africa.

The only Juniors to receive a prize were Ray K. Linsley and William Ackermann, who as co-authors won the Collingwood Prize for Juniors. Carlton B. Jansen, by describing the construction of submerged shipways in a paper for CIVIL ENGINEERING, was awarded the Construction Engineering Prize. The Karl Emil Hilgard Prize was conferred upon Harold A. Thomas and Emil P. Schuleen, both of Pittsburgh. George J. Schroepfer, for his paper on sewage treatment plant operation, was awarded the Rudolph Hering Medal. It should be noted that these prizes are conferred in recognition of services rendered to the profession in the preparation of papers for publication.

Excerpts from the annual report of the Board of Direction, presented at the Wednesday morning meeting, will be available for examination elsewhere in Society publications. The morning business session was brought to a close with the introduction of the President-elect Malcolm Pirnie and the other new officers. Retiring President Ezra B. Whitman and other retiring officers were given an enthusiastic ovation.

More than 400 sat down to the luncheon at the Commodore Hotel for members attending the Annual Meeting. This provided an opportunity to greet acquaintances, many of whom had just arrived. In the afternoon a recessed session of all delegates convened in the auditorium of the Engineering Societies Building to thrash out the problem of collective bargaining. A résumé of action taken at this session appears on page 81 of this issue.

The gayety and charm of the formal dinner dance held in the Grand Ballroom at the Commodore Hotel marked this function as the outstanding social event of the Annual Meeting. About 435 were present. A part of this Wednesday program was the reception in the evening for the incoming President and the new Honorary Members.

Technical Sessions occupied the entire day on both Thursday and Friday. On Thursday six sessions were held by four Divisions. The Hydraulics and Sanitary Engineering Divisions met both morning and afternoon, while the Structural and Construction Divisions had one meeting apiece. Topics of current importance were discussed at these sessions.

The mystery of the mind was probed on Thursday evening at the Smoker by Dunninger, the Mind Reader. Both ladies and men were in attendance for this astounding demonstration—about 1,050 of the former and an estimated 300 ladies in the balcony. Dinner for members preceded this entertainment, which was also held at the Commodore Hotel. Several college reunions were held in conjunction with the Smoker in special rooms set aside for the purpose.

As on Thursday, technical division sessions were held both morning and afternoon on Friday. The Power, Soil Mechanics and Foundations, Surveying and Mapping, City Planning, and Highway Divisions participated. Papers presented at these inter-

MEETING OF OUTGOING BOARD OF DIRECTION, JANUARY 17, 1944

Starting at near corner of table and proceeding clockwise: Charles M. Spofford, Vice-President, Zone I; Gustav J. Requardt, Director, District 5; Ernest E. Howard, Director, District 16; John W. Cunningham, Director, District 12; Ralph B. Wiley, Director, District 9; John W. Cowper, Director, District 3; Scott B. Lilly, Director, District 4; A. M. Rawn, Director, District 11; Charles F. Goodrich, Director, District 6; William D. Dickinson, Director, District 14; N. W. Dougherty, Director, District 10; E. B. Black, Past-President; Charles B. Breed, Director, District 2; Dean G. Edwards, Director, District 1; Van Tuyl Boughton, Director, District 1; E. M. Hastings, Vice-President, Zone II; Fred C. Scobey, Director, District 13; R. E. Bakenhus, Director, District 1; Charles E. Trout, Treasurer; Miss Carolina Crook, Secretary to Mr. Seabury; George T. Seabury, Secretary; Ezra B. Whitman, President; George B. Massey, Director, District 8; Col. William N. Carey, Director, District 7; Thomas E. Stanton, Vice-President, Zone IV.

esting sessions are being reviewed for publication in Society publications. Thus much of the information presented will be available to members who were unable to attend the sessions, through the medium of future Society publications.

Jointly with the Sanitary Engineering Division of the Society, the New York State Sewage Works Association held an all-day session on Friday, including a symposium on grease removal in the afternoon. The annual joint dinner in the evening was in the Hotel McAlpin ballroom.

Another event incidental to the Annual Meeting was the session of the Committee on Technical Procedure discussing various phases of the Society's technical program, on Friday morning.

Throughout the three days of the Annual Meeting, visiting delegates became acquainted with members of the Headquarters staff and with their diverse functions. The two floors of the Engineering Societies' Building occupied by the "Civils" were inspected by many, who made this their headquarters during their New York visit. The seemingly endless functions of the staff were explained to interested visitors.

Special entertainment was provided for the ladies during the Annual Meeting. Luncheon, tea, and a fashion show diverted their attention from the absence of excursions and trips to points of interest usually included in all Society meetings, but now omitted because of transportation and other wartime difficulties. The ladies were privileged to see a preview of the new Warner Brothers' picture, "Destination Tokyo." Visits by small groups were made to points of special interest about the city, including Rockefeller Center, broadcasting studios, churches, universities, museums, and, need it be said, the numerous fine shops for which the metropolis is noted.

As usual, the careful planning of the Annual Meeting Committee bore fruit in the form of a most worth-while event. Unusual interest in the affairs of the Society was expressed by delegates and others from Sections all over the United States. The well-arranged technical sessions and social affairs bore witness to the loyal and conscientious work of many members in various fields of interest. A most enjoyable time was had by all, even including officers, who were in business meetings for all, or parts of, the five days, starting on Sunday. The large attendance and keen enthusiasm give some measure of the accomplishments of this the Ninety-first Annual Meeting of the American Society of Civil Engineers.

Binding of "Transactions" Proceeds

DELAY in the binding of the cloth and morocco volumes of the 1943 TRANSACTIONS was noted in the December issue, page 599. In the meantime the difficulties have somewhat increased and it is necessary to remind members again and to ask their indulgence.

Those who have had to contend with difficulties of labor and material in war days will fully understand the problem. This binding work is making as fast progress as conditions will permit. Many of the cloth-bound volumes have been put in the mails and should be in the hands of members shortly.

As regards copies in half-morocco binding, the expectation is that mailing will occur some time in February. It should be realized that this is a prospect and not a promise. But it will relieve the doubts in the minds of scores of members who have written in to report non-delivery of their volumes.

It is believed that members will willingly undergo the inconvenience and delay in view of the wartime conditions under which this work is being done.

Activities of the Committee on Employment Conditions, 1937 to the Present

Presented at the Recessed Business Meeting of the Society on January 19, 1944, New York, N.Y.

HISTORICAL BACKGROUND

WITHIN the Society in 1937 a Committee on Unionization was created, the function of which was to report to the Board of Direction on the degree of unionization among engineers and to recommend to the Board suitable courses of action. This report was printed in the March 1938 issue of CIVIL ENGINEERING on page 216, and closing its report the Committee made the following recommendations:

1. Membership in a trade union is primarily an economic matter. Therefore the American Society of Civil Engineers should consider such membership as having no more bearing on a man's qualifications for membership in the Society than have his religious or political affiliations.
2. The Wagner Labor Relations Act has encouraged the extension of existing unions and the formation of others; it has paved the way for complete unionization of the employees of many industries and may be expected to result in the formation of collective bargaining groups in all plants and offices where any considerable numbers of men are employed. Engineers and architects as well as draftsmen and other sub-professional men are not and cannot be exempted from the provisions of the act. Therefore, the Society should not participate in any movement to amend the act to exclude professional men from its provisions. Such a movement would be bound to fail as many engineers believe that collective bargaining can be made to work to their advantage and will fight for their rights under the Wagner Act.
3. The Society should support efforts to amend the Wagner Labor Relations Act to clarify the position of professional and sub-professional men under the act should that appear necessary.
4. Extension of unionization to include a large part of the employees of some industries and its possible extension to many other organizations has made it desirable in some instances for engineers to organize to protect their own rights. In other instances engineers have organized or have joined existing trade unions in the belief that they can better their economic position thereby.

These existing trade unions are far from ideal to represent engineers in collective action. Experience has shown that such action can be taken by engineers themselves without resort to strikes and other trade-union tactics. Therefore, on the assumption that the need for facilities for collective action by engineers will increase at least temporarily in the future as the organization of industry expands, the Society should stand ready to cooperate with other Founder Societies or with state and national professional societies in the establishment of temporary or permanent agencies to represent engineers in collective action in a dignified professional manner whenever necessary.

5. To minimize the need for collective action by engineers as well as to assist its members in establishing and maintaining adequate and reasonably uniform compensation for the several grades of engineering employment, the Society should adopt a schedule of grades and minimum compensation such as is now before the Board of Direction. The Society should seek actively to have such a schedule widely accepted and should be prepared to cite a member for unethical practice who pays less than the established minimums for the region in which his business is conducted, except under emergency conditions.

These were conclusions reached in 1938. Since then, this subject has had the consideration of the Board more or less continuously until the title of the committee was changed to "Committee on Employment Conditions" and it was given a broader function than theretofore. This broader function was authorized October 1941 as a result of a resolution formulated in the Local Section Conference of July 1941, wherein it was "Resolved that the Board of Direction of the Society shall establish a policy on a nation-wide basis for the Local Sections to follow in the matter of unionization; that it shall promptly formulate and put such a policy into action; and that it shall request the cooperation of the Founder Societies in this matter." Following the recommendation, the Board authorized the appointment of a staff member to devote his whole time to the study of this matter of engineer employer-employee problems.

The new Committee on Employment Conditions submitted a report in April 1942 to the Board of Direction which emphasized the following three points:

1. That the American Society of Civil Engineers shall attain its objectives by fair and reasonable means that take into consideration all sides of a question and the rights of all parties concerned.
2. That the Society shall attack the root of conditions that tend toward dissatisfaction with employment conditions among engineers:
   a) By continuing to completion its classification of engineering positions and accompanying salary schedule and making the results thereof available for widespread use.
   b) By adjusting disputes and the correction of discriminating practices affecting engineers.
   c) By eliminating practices or tendencies detrimental to the free practice of engineering.
3. That the Society extend aid as promptly and efficiently as possible to men in subordinate positions who may need aid in employment matters, recognizing that Juniors particularly may need such aid.

A nation-wide investigation of the degree of unionization among engineers was started March 1, 1942. This investigation was conducted in all parts of the country, several hundred people being interviewed. A report of this investigation was prepared and presented to the Board of Direction at the July 1942 meeting and excerpts from that report were published in CIVIL ENGINEERING in September 1942, on pages 527, 528. This report disclosed the extensive activities of pressure, or bargaining, groups supported by professional engineers as well as those in the sub-professional status. After submission of this report to the Board of Direction, the Board commissioned the staff to be of assistance wherever possible in matters relating to employment conditions.

DETAILED ACTIVITIES OF THE COMMITTEE

As a result of this commission to be of assistance wherever possible in employment difficulties, members of the staff have traveled many thousands of miles and have interceded for both employees and employers in rectifying employment differences. At this time it would not be possible to give an account of all the cases which have occupied the attention of the staff and the Committee as a result of these activities. Nevertheless, accounts will be given of the more important details. Before starting these accounts, it should be noted that prior to March 1, 1942, another staff member, now in the Army, carried on similar activities which resulted in improvements in economic conditions in the State Highway Departments in Arizona, Nevada, and Nebraska. Also, immediately prior to March 1, 1942, two cases of union activities among professional engineers were called to the attention of the Board of Direction by members of the Society who were working on the construction of the St. Louis Ordnance Plant and the T.N.T. plant at Weldon Springs, Mo. Union groups carried these difficulties to the National Labor Relations Board but the projects were completed before the differences were adjusted.

In the interval from July 1942 to January 1944, assistance and advice have been given to engineers in cases involving both individual engineer employees and groups of engineer employees working on the construction of bomber training schools, ordnance works in different parts of the country, and other types of large war construction. Assistance and advice have been given also to employers of engineers working on war construction, as well as to employers with small consulting offices, and to highway employees in several states. Conferences have been held, upon request, with representatives of architects and mechanical, electrical, chemical, and mining engineers; and with individuals involved in union difficulties in large public utility organizations. In addition, numerous conferences have been held with officials in the U.S. Civil Service, the U.S. Engineer Corps, the National Labor Rela-

tions Board and the U.S. Conciliation Service, other departments of the Government; and with various professional societies or their representatives.

THE EXTENT OF GROUP ACTION

The nation-wide investigation, started in March 1942, disclosed that there are two large unions, the IFTEA and DU of the A F of L and the FAECT of the CIO, the activities of which are directed towards the organization of the professional engineer, architect, and chemist and all in sub-professional status in these three professions. In addition, there are several smaller unions organizing this field, some of which are affiliated with the A F of L and some with the CIO.

In addition to these groups of professional and sub-professional engineers affiliated with the A F of L or CIO, there are many other groups of engineers which are not affiliated with either of these unions. One of these groups is the TVAEA. Another is the Association of Railway Technical Employees of the Southern Pacific Railway Company. In many parts of the country there are independent bargaining groups in individual plants or on individual projects. In some states there are groupings of state highway employees, in others strong, active state engineering societies. It is safe to say that several thousands of professional engineers and their helpers are enrolled in these independent unaffiliated groups.

THE REASONS FOR GROUP ACTION AMONG ENGINEERS

There are two basic reasons for the establishment of group activities among members of the engineering profession and their assistants. The first is that there are many instances where engineering employees need assistance in matters relating to employment conditions. The second is that the Wagner Act, as written, applies to all employees, including those who are members of the learned professions.

In recent years there has come into existence a series of legislative enactments dealing with employment matters, culminating in the National Labor Relations Act which gives and upholds the right of employees to join together for collective bargaining purposes. The term "employee" is defined as "any employee," which includes the employee engineer and all his assistants. On the other hand, the Fair Labor Standards Act of 1938, which specifies minimum wages and maximum hours of work, clearly exempts the professional man from the provisions of that particular act. In addition, in the explanations of the Fair Labor Standards Act, there is an elaborate definition of the professional man. This means that, as the law stands, the professional man is exempt from the provisions of the Fair Labor Standards Act but, if he is an employee, he is subject to the provisions of the collective bargaining law.

The National Labor Relations Act, in giving and upholding the right of employees to join together for collective bargaining purposes, makes it necessary for the formation of groups, and by the same token, it makes individual action difficult in matters relating to employment conditions. The individual employee therefore no longer has an individual voice in matters relating to his employment. In order to have a voice he must join together with others of similar interests. Thus, groups are formed, and in practice it has been ruled that these groups must be self-administered and self-financed.

The professional engineer, as a result of his education and his experiences, has always been an individualist. When he is in employee status, he has tried to maintain that individuality in regard to employment conditions. This has resulted in the formation of groups by those who are not of professional stature but who work with those who have professional stature. These groups, promoted by the A F of L and the CIO, however, have assumed the right to bargain for the entire engineering classification, and because the professionally minded engineer has been slow to take advantage of his rights under the law, these groups dominated by sub-professionals, have assumed in many instances his rights and have bargained for him.

Thus, the professional engineering employees have found themselves a minority in a bargaining group dominated by sub-professionals, or standing out as individuals from a bargaining group dominated by sub-professionals, and taking no part in their activities. In some cases the professional man has been forced, against his will, to join closed-shop bargaining groups. In other cases labor union organizers have dictated to employer engineers which of their engineer employees shall be hired and which shall be laid off, as well as other terms of their employment.

To sum up, professional engineering employees are faced with the following choices: they can remain unaffiliated with a group which, dominated by sub-professionals, bargains for them; or they can join with such a group dominated by sub-professionals which bargains for them; or they can form an independent bargaining group composed of professional men of their own type and choose their own course of action.

A. M. RAWN
Chairman, Committee on Employment Conditions

Annual Business Meeting

Board's Action on Collective Bargaining Tested at Annual Meeting

THE PLAN for the establishment of local collective bargaining groups in the various Local Section areas, adopted by the Board of Direction at its October 1943 meeting, was discussed fully and freely at the three-hour recessed Business Meeting of the Society on the afternoon of Wednesday, January 19, at the time of the Annual Meeting in New York.

During the morning session it was moved and seconded "that it is the sense of this meeting that the Board of Direction at its stated meeting tomorrow, January 20, 1944, reconsider:

"(1) The action of the Board of Direction at its Atlanta meeting, October 11, 1943, with respect to the adoption by the Board of the report of the Society's Committee on Employment Conditions.

"(2) And defer any further action in the matter until the whole membership of the Society has had an opportunity to review the pertinent facts in the case and express their views to your Honorable Board."

President Whitman stated that, as it had been announced that the whole afternoon was to be devoted to a discussion of the topic, he would make the motion the first order of business of the recessed session.

In the afternoon, the auditorium in the Engineering Societies Building was well filled with members and other interested persons, who participated in a spirited debate. During the three-hour discussion of the motion, 35 consecutive statements and questions were presented by members both in support of, and in opposition to the plan.

Statement of experiences observed on recent contracts were related by an authority in the War Department, speaking, upon request, as for himself and not officially for any department of the Government. Dr. C. L. Parsons, Secretary of the American Chemical Society, told of the experiences undergone by chemists and chemical engineers and the procedures taken and contemplated as to be taken by that Society. Also the Chairman of the Society's Committee on Employment Conditions told of the study given by the Board of Direction to the problem during the past year and a half—of the development of a specific plan by the Committee and its adoption by the Board. The members of the Committee were on the platform, available to answer questions.

At five-thirty o'clock calls for the "the question" stopped the debate and a standing vote was taken in which 217 Corporate Members participated. Following the count, the motion was declared "Lost," 97 votes being in favor and 120 votes in opposition to the motion.

Fifteen Sections Adopt Collective Bargaining Amendment

AS THE February issue of CIVIL ENGINEERING goes to press, 15 Local Sections have notified Headquarters of their adoption of the collective bargaining amendment to their constitutions. The recommended amendment was recorded on page 552 of the November 1943 issue of CIVIL ENGINEERING.

A list of those Sections reporting, and the percentage of votes cast for and against follows:

Section	Percentage of Vote	
	Affirmative	Negative
Central Ohio	94%	6%
District of Columbia	93	7
Georgia	..*	..*
Kansas City	92	8
Los Angeles	96	4
Maryland	97	3
Miami	..*	..*
Oklahoma	93	7
Oregon	..*	..*
Pittsburgh	89	11
Puerto Rico	..*	..*
San Diego	86	14
Seattle	97	3
Tennessee Valley	95	5
West Virginia	86	14
Average percentage	93	7

* Precise figures have not yet been reported.

In 15 other Sections the subject has been discussed in open meeting and the amendment is in process of being balloted on.

In one Section the decision has been made by the local board of directors that the proposal to amend the constitution shall not be put before their membership, as believed to provide procedure deemed unnecessary in its area.

One Section has reported that, through a misunderstanding, the amendment as balloted upon failed to pass.

His Fifty-First Annual Meeting

AN ENTHUSIASTIC participant in the Society's Annual Meeting was Herbert Cary Keith, now of New Haven, Conn., elected a Member in 1889 and now 82 years old. He insists that his life has been full of happy associations with the Society. This is his fifty-first attendance at the Annual Meeting held each year in New York.

He missed the 1902 and 1903 meetings because he was in the West and business would not permit of his making the trip. The 1931 meeting he missed because he had to undergo an emergency, but minor, operation. The only other Annual Meeting he has missed since his election to membership nearly fifty-five years ago was that of 1936, when he was visiting in Japan. Can other Members of the Society tie, or better, this record?

Final Ballot on 1943 Society Officers

To the Ninety-First Annual Meeting *January 12, 1944*
American Society of Civil Engineers:

The tellers appointed to canvass the ballot for officers of the Society for 1944 report as follows:

For President

Malcolm Pirnie	4,113
Scattering	5
Blank	20
	4,138

For Vice-Presidents

Zone I:

Richard Erwin Dougherty	4,103
Scattering	2
Blank	33
	4,138

Zone IV:

Franklin Thomas	4,104
Scattering	4
Blank	30
	4,138

For Directors

District 3:

Solomon Cady Hollister	4,096
Scattering	4
Blank	38
	4,138

District 5:

Gail Abner Hathaway	4,102
Scattering	3
Blank	33
	4,138

District 7:

Raleigh Welch Gamble	4,101
Scattering	3
Blank	34
	4,138

District 8:

Wilbur M. Wilson	4,102
Scattering	2
Blank	34
	4,138

District 9:

Frank Clifton Tolles	4,106
Scattering	2
Blank	30
	4,138

District 12:

William Day Shannon	4,098
Scattering	3
Blank	37
	4,138

District 16:

Royce Jay Tipton	4,091
Scattering	11
Blank	36
	4,138

Ballots canvassed	4,138
Ballots withheld from canvass:	
From members in arrears of dues	6
Without signature	55
With illegible signature	2
Total withheld	63
Total number of ballots received	4,201

Respectfully submitted,
JAMES MCB. WEBSTER, *Chairman*

William H. Dieck	Edwin P. Pitman	Howard Holbrook
Louis Goodman	David G. Baillie, Jr.	Harry W. Stuber
Alfred M. Wyman	Frank L. Greenfield	Albert P. Loriot
Harry Newman	Rudolph F. Schaefer	Joseph Farhi
Solomon B. Arison	Theodore P. Kilian	*Tellers*

Hal H. Hale Becomes Secretary of Highway Association

AT the beginning of the year Hal H. Hale, for the past two years Washington representative of the Society, took up new duties as executive secretary of the American Association of State Highway Officials. His headquarters will continue to be in Washington. Before joining the staff of the Society—in November 1941—Mr. Hale was district office engineer for the Atlanta (Ga.) district of the Portland Cement Association.

Hospitality Extended to Society Members in Australia

A RECENT letter from the Institution of Engineers, Australia, addressed to the President of the Society, offers hospitality to members of the Society in service in Australia. The letter reads in part:

"We are very glad to have the present opportunity for cooperation and personal contact between the engineers of our two countries and hope that as many as possible of your members here will make full use of such privileges as it is in our power to extend, including attendance at meetings, the right of receipt of publications, and access to our reference libraries.

"Many engineers of the United States Forces have availed themselves of our invitation when they have been able to do so, and we have found it very pleasant to make their acquaintance and show them some hospitality; but we should be glad of your help in giving wider publicity to our wish to enable your men and ours to keep in touch with each other and with their profession."

The headquarters of the Institution is Science House, Gloucester and Essex Streets, Sydney, N.S.W. Other Divisions are located in Adelaide, Brisbane, Canberra, Melbourne, Newcastle, Perth, and Tasmania.

Government Lists Society as Essential

DIFFICULTIES in keeping the Headquarters staff intact, and in securing needed supplies and equipment, have led to an official inquiry on the part of the Society as to its status in the war effort. Specifically, the War Manpower Commission was asked to determine the value of the Society, based on its publications and other activities. The reply, from the Acting Area Director in New York City, states that:

"The publication of scientific, technical and engineering books and journals and services of the same kind rendered to government agencies or to the war program are included in the List of Essential Activities.

"On the basis of the information supplied in your communication, all of the efforts of your society are devoted to these activities. It is, therefore, interpreted as being engaged in an essential activity entitled to all of the benefits of the Employment Stabilization Program of the New York City Area.

"Employees of your establishment are essential employees and may not accept other employment except in conformity with the program."

This decision will be helpful in a material way, enabling the Society to prosecute its work with greater efficiency. It is also gratifying to both staff and members to realize the high estimate placed on this work by the War Manpower Commission.

Members Direct Army Railroad Operations

THAT the temporary government operation of the railroads under the Army had expert direction was indicated by the choice of a number of engineers for highly responsible duties. As announced on December 28, 1943, by Secretary of War Stimson, the following members of the Society occupied important posts:

Lt. Gen. Brehon B. Somervell, Hon. M. Am. Soc. C.E., commanding the Army Service Forces, placed in charge of government operation

Maj. Gen. C. P. Gross, M. Am. Soc. C.E., chief of transportation, Army Service Forces, directly responsible for operation under General Somervell

Ralph Budd, Hon. M. Am. Soc. C.E., president of the Burlington Railroad, one of seven regional administrators, in charge of the Central-Western Region

L. W. Baldwin, M. Am. Soc. C.E., president of the Missouri Pacific Railroad, administrator in charge of the Southwestern Region

Commissions as colonels were given to Messrs. Budd and Baldwin, as well as to the other regional administrators. Appointment of four members of the Society in the top ten for the operation of American railroads was a great tribute to the profession.

News of Local Sections

Scheduled Meetings

CLEVELAND SECTION—Dinner meeting at the Cleveland Engineering Society on February 11, at 6:30 p.m.

COLORADO SECTION—Dinner meeting at the Edelweiss Restaurant on February 14, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on February 21, at 12:15 p.m.

ILLINOIS SECTION—Luncheon meeting at the Chicago Engineers' Club on February 10, at 12:15 p.m. (talk on "Soil Classifications and Characteristics" by Earl J. Felt).

IOWA SECTION—Meeting held in conjunction with the annual meeting of the Iowa Engineering Society at Hotel Fort Des Moines on February 23, at 9 a.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on Feburary 9, at 6:45 p.m.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on February 16, at 8 p.m.

MIAMI SECTION—Dinner meeting at the Royal Center on February 3, at 7 p.m.

NORTHWESTERN SECTION—Dinner meeting at the Campus on February 7, at 6:30 p.m.

PHILADELPHIA SECTION—Social meeting at the Engineers' Club on February 19, at 6:15 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12 m.

SAN FRANCISCO SECTION—Dinner meeting at the Engineers' Club of San Francisco on February 15, at 5:30 p.m.

SEATTLE SECTION—Annual business meeting at the Engineers' Club on February 28, at 8 p.m.

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section at the S & W Cafeteria on February 8, at 5:45 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Y.M.C.A. on March 6, at 12:15 p.m.

TRI-CITY SECTION—Dinner meeting at the Fort Armstrong Hotel on March 2, at 6:30 p.m.

Recent Activities

ALABAMA SECTION

The thirteenth annual meeting of the Section took the form of a two-day session in Montgomery on December 10 and 11. The morning of the 10th was devoted to registration, and the afternoon to a technical program on highway problems, present and postwar. Those taking part in the symposium were G. R. Swift, S. W. Harbin, and W. G. Pruett, respectively, highway director, chief engineer of surveys and plans, and office engineer for the Alabama State Highway Department; and Berrien W. Davis, maintenance engineer for the North Carolina State Highway Department. In the evening there was an informal dinner and joint meeting with the Montgomery Engineers' Club, with N. W. Dougherty, Society Director from District 10, as principal speaker. Dean Dougherty's subject was "The Transition of Civil Engineering to a Postwar Era." Howard F. Peckworth, assistant to the Secretary of the Society, also spoke, his topic being collective bargaining for engineers. Participants in the Saturday morning technical program were Col. L. S. Vance, assistant chief of staff, Eastern Flying Command, Army Air Forces; T. H. Milford, chief engineer and director of the State (Alabama) Bureau of Sanitation; and Sidney W. Smyer, member of the Southeastern Regional Planning Commission. The annual election of officers concluded the program. New officers will be R. A. Smallman, president; A Reese Harvey, first vice-president; Truman A. Smith, second vice-president; and J. F. Tribble, secretary-treasurer.

ARIZONA SECTION

On November 27 members of the Arizona Section met at Phoenix for an all-day discussion of business and technical problems. During the morning session L. O. Fiscel was elected president for the coming year, and George Grove, vice-president for two years.

The joint luncheon with the Arizona Association of Engineers had been arranged by the latter group. Entertainment for the occasion consisted of a talk on "Research in the Stratosphere and Three Years at the South Pole"—given by L. C. Musselman, supervising engineer for the High Altitude Laboratory AiResearch Manufacturing Company. Mr. Musselman was aide to Admiral Byrd on his 1938–1941 South Pole expedition. The afternoon session opened with a paper on magnesium, presented by Alvin Larson, structural engineer for Basic Magnesium, Inc. The other scheduled speakers were C. S. Howard, chemist for the U.S. Geological Survey, whose subject was "Quality of the Waters of the Southwest," and E. J. Wheeler, assistant head of the U.S. Engineer Office of Los Angeles, who presented a paper on the design of sub-bases for airport landing fields.

BUFFALO SECTION

At the December meeting of the Section the following new officers were elected for the coming year: Newell L. Nussbaumer, president; H. C. Woods, vice-president; A. Stuart Collins, secretary; and Martin H. Brennan, treasurer. The retiring president of the Section, Norman M. Herthe, spoke briefly, as did various committee members. The subject of postwar planning was discussed in some detail, the consensus of opinion being that private industry must provide most of the postwar employment.

CENTRAL ILLINOIS SECTION

The scheduled speaker at the November meeting of the Central Illinois Section was F. R. McMillan, director of research for the Portland Cement Association. Slides and motion pictures were used to illustrate his talk, which was entitled "A Long-Range Program of Cement Research." The technical program for the December meeting consisted of an illustrated lecture on the Illinois oil fields, presented by Dr. Carl A. Bays, special geologist for the Illinois State Geological Survey. The annual election of officers, held at this time, resulted in the selection of the following: H. E. Babbitt, president; H. A. Spafford, first vice-president; T. C. Shedd, second vice-president; and James G. Clark, secretary-treasurer.

CINCINNATI SECTION

On November 18 the Cincinnati Section met with the Engineering Society of Cincinnati and the local chapter of the American Institute of Architects. Following a buffet dinner, two interesting travel films were shown. The group then heard Alfred Bettman, chairman of the Cincinnati Planning Commission, speak on the topic, "Planning the Future Metropolitan Cincinnati." A film and lecture on Ohio River navigation comprised the technical program at the December meeting, the speaker being Frederick B. Duis. Now retired, Mr. Duis was formerly principal engineer for the Ohio River Division of the U.S. Engineer Office.

CLEVELAND SECTION

Thrilling experiences aboard the *Marblehead* were described by Comdr. M. Smellow, of the U.S. Navy, at the December meeting of the Section. In the early days of the war the vessel suffered two direct hits from Japanese bombs but, with the pumps working continuously, managed to keep afloat and arrived at a United States port three months to the day after suffering the bombing. Dubbed "unsinkable," the ship has been back in service for the past year. Presentation of the Section's prizes of Junior membership in the Society concluded the program. The winners this year are A. H. Barnes, of the Case School of Applied Science Student Chapter, and William Spencer, of the Ohio Northern University Chapter.

COLORADO SECTION

Tales of pioneer days in Denver enlivened the annual meeting of the Section, which was held on the 13th, the speaker being Joseph Emerson Smith. The election of new officers resulted in the choice of E. Warren Raeder, for president; Carl P. Vetter, vice-president; and Jacob E. Warnock, secretary-treasurer.

DAYTON SECTION

On December 20 John Hale, city engineer of Dayton, discussed postwar projects for the city of Dayton. All the projects covered have been selected for their potential value by a committee of citizens, and the speaker explained each project and its relative usefulness.

ILLINOIS SECTION

Unusual interest was evinced in the annual meeting of the Section—held on December 17—when T. R. Agg spoke on collective bargaining. Dean Agg is a Vice-President of the Society. The annual election of officers resulted as follows: J. F. Seifried, president; C. P. Hazelet, vice-president; and G. S. Salter, secretary.

KANSAS CITY SECTION

A symposium on problems of bridge design, construction, maintenance, and financing was the feature of the seventh annual meeting of the Section, which took place on December 9. This was presented by members of the firm and technical staff of Howard, Needles, Tammen and Bergendoff—Messrs. E. E. Howard, R. H. Bergendoff, C. S. Harper, J. Sorkin, I. C. Watkins, George Acre, Carl L. Erb, and T. J. Cambern. The talks, which presented highly instructive data on ancient and modern bridge engineering, were supplemented by displays and slides. During the annual business meeting the following officers were elected: O. W. J. Auchuetz, president; M. P. Hatcher, first vice-president; C. R. Van Orman, second vice-president; and A. N. Mitchell, secretary-treasurer.

KENTUCKY SECTION

The speaker of the evening at the annual meeting of the Section—held in Louisville on December 10—was Robert B. Brooks, St. Louis (Mo.) consultant and former Director of the Society. Mr. Brooks discussed the construction of the Burma Road and life among the Chinese. A technicolor sound film, entitled "Kukan, the Battle Cry of China," concluded the technical program. The new officers for the Section are W. S. Todd, president; H. J. Sundstrom, vice-president; C. W. Lovell, secretary-treasurer; and A. M. Judd, corresponding secretary.

LOS ANGELES SECTION

"Postwar Industrial Development" was the subject of discussion at the December meeting of the Section, the principal speaker being James F. Bone. Mr. Bone, who is industrial expert for the Los Angeles Chamber of Commerce, sketched the phenomenal development of Los Angeles as an industrial area. In 1920 the Los Angeles area ranked seventeenth industrially. Since 1939, due to the concentration of war industries in the region, it ranks second only to Detroit. Later in the evening Director A. M. Rawn addressed the group on the subject of unionization of engineers. Induction of officers for 1944 concluded the program. They are Don Hall McCreery, president; Wallace L. Chadwick and L. J. Alexander, vice-presidents; A. H. Jessup, secretary; and Sterling S. Green, treasurer.

METROPOLITAN SECTION

At the December meeting of the Section, Waldo G. Bowman spoke on the subject, "United States War Construction in Britain and the Middle East." Mr. Bowman, who is editor of *Engineering News-Record*, recently returned from a 25,000-mile trip, which took in all the war fronts that have been established around Axis Europe. In England he saw Army Engineer construction work at bomber bases, camps, and depots. In North Africa he visited military installations in the desert, and in Iran he witnessed the building and operation of supply lines by U.S. Army Engineers, by means of which huge quantities of war materials are being moved into Russia.

MOHAWK-HUDSON SECTION

On December 14 members of the Mohawk-Hudson Section gathered at Rensselaer Polytechnic Institute for their annual meeting. During the election of officers Arthur W. Harrington was chosen president. The other new officers are G. Reed Shaw, vice-president; Arnold G. Fisch, secretary; and Clyde P. Parkinson, treasurer. The technical program consisted of a talk by A. N. Carter, assistant editor of *Engineering News-Record*, on the Inter-American Highway. His lecture was illustrated with slides and maps. Members of the Student Chapter at Rensselaer Polytechnic Institute met jointly with the Section.

PANAMA SECTION

At its fourteenth annual meeting, which was held in Panama City on December 6, the Panama Section elected the following officers for 1944: Arthur Donaldson, president; Wells D. Wright, first vice-president; Forrest L. Dye, second vice-president; and J. P. Smith, secretary-treasurer. Following the annual dinner, T. F. Thompson, geologist of the special engineering division of the

STUDENT CHAPTER MEMBERS WERE GUESTS OF THE ST. LOUIS SECTION AT ITS ANNUAL DINNER MEETING

Panama Canal, addressed the gathering on "The Limestones of the Republic of Panama and Their Economic Utilization." Slides were used to show the geologic formations and the locations of the deposits.

ROCHESTER SECTION

On December 16 members of the Rochester Section and their wives were entertained at the home of Mr. and Mrs. Henry L. Howe. Following dinner, Hiram E. Bryan gave an illustrated talk on the history of the Genesee country. At the annual meeting of the Section, which took place on January 6, the following new officers were elected for the coming year: Eldred H. Walker, president; Harry W. Eustance, first vice-president; Vernon E. Warney, second vice-president; and Cecil Aronson, secretary-treasurer. The speaker of the evening on the latter occasion was S. C. Hollister, dean of the college of engineering at Cornell University, who addressed the group on the subject, "A Program for Local Sections."

SACRAMENTO SECTION

Most interesting of the Section's five regular meetings in November was the session at which colored movies, showing an engineer's reaction to a trip to Mexico, were presented by Gilbert Mellin. A sound movie of the "Big Inch," entitled "Oil for War," was also shown at this session. The crowning attraction of the four regular meetings held in December was as usual the annual Christmas Jinks. This gathering took the form of a luncheon, with Director Fred C. Scobey as guest of honor. The luncheon was preceded by a cocktail party and followed by a one-act farce burlesquing the possibilities of uncontrolled unionism. At the last meeting of the year, Francis N. Hveem, senior physical testing engineer for the California State Division of Highways, presented an abstract of a paper on "Cement Base Construction," which had been prepared by Vice-President Stanton, James Beatty, and himself.

ST. LOUIS SECTION

Student Chapter members from Washington University and the Missouri School of Mines were guests of the St. Louis Section on the occasion of its annual dinner meeting, which was held on December 4. Students from the University of Missouri were unable to attend because of transportation problems. During the annual election of officers Robert W. Hodson was elected president for the coming year. The other new officers are Robert B. Brooks, vice-president; A. H. Baum, councillor; and E. E. Rippstein, secretary-treasurer. Chancellor George R. Throop, of Washington University, spoke briefly, and was followed by Society Director W. D. Dickinson, who discussed the activities of the Society. The guest of honor and principal speaker of the evening was Rear Admiral Ben Moreell, Honorary Member of the Society and chief of the Bureau of Yards and Docks. Admiral Moreell discussed "The Civil Engineer in the Navy" and described some of the amazing accomplishments of the "Seabees," the newest branch of the Corps. His address was followed by a sound film showing the "Seabees" in action all over the world, from the South Seas to Salerno. Admiral Moreell is a native of St. Louis and a graduate of Washington University. On December 2, the Section met jointly with the Engineers' Club of St. Louis to hear Dr. Frank W. Bubb, head of the department of applied mathematics at Washington University, speak on the philosophy and history of mathematics.

SAN FRANCISCO SECTION

At the annual meeting of the San Francisco Section, which took place on December 21, the technical program consisted of an address by Morrough P. O'Brien, dean of the college of engineering at the University of California. Dean O'Brien's subject was "Preparation for an Engineering Career."

The Junior Forum met on December 2 to hear talks by two members of the Section—George Solnar and John Server, Jr. The former's subject was "Fundamental Development in Suspension and Construction for a Railroad Car," while Mr. Server spoke on "The Reclamation Future of the West." Collective bargaining for professional engineers was the topic for general discussion.

TENNESSEE VALLEY SECTION

On December 14 the Chattanooga Sub-Section had a joint dinner meeting with local groups of the other Founder Societies. The technical program consisted of talks by P. B. Hill, civil engineer for the Tennessee Valley Authority, whose subject was postwar construction; and Frank Stevens, of the American Lava Corporation, who described a recent trip to England. A motion picture on the control of malaria concluded the program.

The Knoxville Sub-Section called a special dinner meeting on November 30 to hear Oren Reed discuss the construction of Fontana Dam. Mr. Reed, who was construction engineer for the TVA on the dam, illustrated his remarks with a colored motion picture. The regular meeting, which was held on December 14, took the form of a Christmas party.

TOLEDO SECTION

A lecture on oil exploration in South America comprised the technical program at the December meeting of the Toledo Section. This was given by H. C. Hotchkiss, field engineer for the Texas Company at Bogota, Colombia, who explained the work of the seismograph in the search for new oil fields. At the conclusion of the technical program, it was announced that Lawrence M. Friedrich has been elected president for the coming year, and Carleton S. Finkbeiner, second vice-president. W. P. Sanzenbacher automatically moves from second to first vice-president, and Robert E. Brown continues as secretary-treasurer.

UTAH SECTION

The Utah Section announces that its new officers, elected on December 9, are A. Diefendorf, president; H. S. Carter, first vice-president; R. G. Harding, second vice-president; and F. H. Richardson, secretary-treasurer. Professor Diefendorf, who is head of the department of civil engineering at the University of Utah, was the principal speaker and discussed the effect of the Army Specialized Training Program on engineering students.

WYOMING SECTION

Present conditions in Turkey were discussed by J. Gardner Bennett, of the engineering staff of the University of Wyoming, at the December 7th meeting of the Section. Professor Bennett has just returned from Istanbul, where for three years he was head of the civil engineering department at Robert College. The meeting was a joint session with the Cheyenne Engineers' Club.

ITEMS OF INTEREST

About Engineers and Engineering

The Great Wall of China—Greatest Work of Man

By J. CHARLES RATHBUN, M. AM. SOC. C.E.

PROFESSOR OF CIVIL ENGINEERING, COLLEGE OF THE CITY OF NEW YORK, N.Y.

IF TEN men were asked to name the greatest engineering work, either ancient or modern, probably no two answers would be the same, and not one would mention the greatest. Such is the effect of lack of publicity. The Great Wall of China may not be the most spectacular, the most influential on world progress, or the most ingenious in conception—although it ranks high in all these qualities—but it certainly is the greatest.

Its volume has been estimated at over three billion cubic feet. It contains enough material to form a cube 1,470 ft on an edge, or enough to cover the 22 sq miles of Manhattan Island with a layer over 5 ft thick. Compare this with the size of Gaillard Cut, Boulder and Grand Coulee dams, an Egyptian pyramid, or any other structure.

If the Wall were superimposed on the United States, in the same latitude but with a change of 165° of longitude from its present position (Fig. 1), the east end would be in northeast Maine while the west end would be northwest of Kansas City, adding greatly to the scenic interest of both places, as well as to that of the Pennsylvania Turnpike. Philadelphia, Columbus, Louisville, St. Louis, and Kansas City would point with pride to "our wall!" Pittsburgh would be on the North Branch. The best-known section, the "Tourist Wall," which lies just north of Peiping, would fall at Morgantown, W. Va., and rival the Galatin Home as a place of interest. The junction of the north and south walls would add a "Y" to the fame of Xenia, already well known in crossword puzzles and spelling bees. The Tibet Loop would wander all over the Ozark Mountains.

According to popular legend, the first design of the Wall called for a series of masonry towers within shooting (bow-and-arrow) distance of each other. This was hardly adequate either as a boundary marker or as a line of defense, so curtain walls were added between the towers. The labor organization was simple, effective, and economical. A million men, more or less, with their families, were drafted; two-thirds of them farmed and supported the others, who worked on the Wall. The time required for the construction is estimated at from seven to fourteen years.

Every one worked for the good of his Emperor, his country, and his job. If a workman flagged in his efforts, he left China at once. If his value was negative, his widow left soon after. This system developed peace and harmony and there were no strikes or labor agitations. The builders got along like one big, happy family.

More prosaic historians indicate that the Wall as originally built was but a pile of earth, not unlike a railroad grade, and probably not very high. This served well as a boundary marker. The time of construction can hardly be given, for this simple wall was enlarged, improved, repaired, and extended until some time in the sixteenth century, when its days of usefulness were over. Along most of its length it is 20 to 50 ft or more in height and over 15 ft thick. Both faces are of brick or cut stone and very nearly vertical. The towers are of the same general construction. They formed a housing for the patrol on the Wall.

That the narrow facing acted successfully as a retaining wall through the centuries shows the care with which the rubble core was placed and compacted. Where necessary, the top of the wall was paved and drainage provided for. In some places in the deserts of the far west the facing is omitted, and the dirt is bound together with willow brush. Much of this brush is still in place and well preserved.

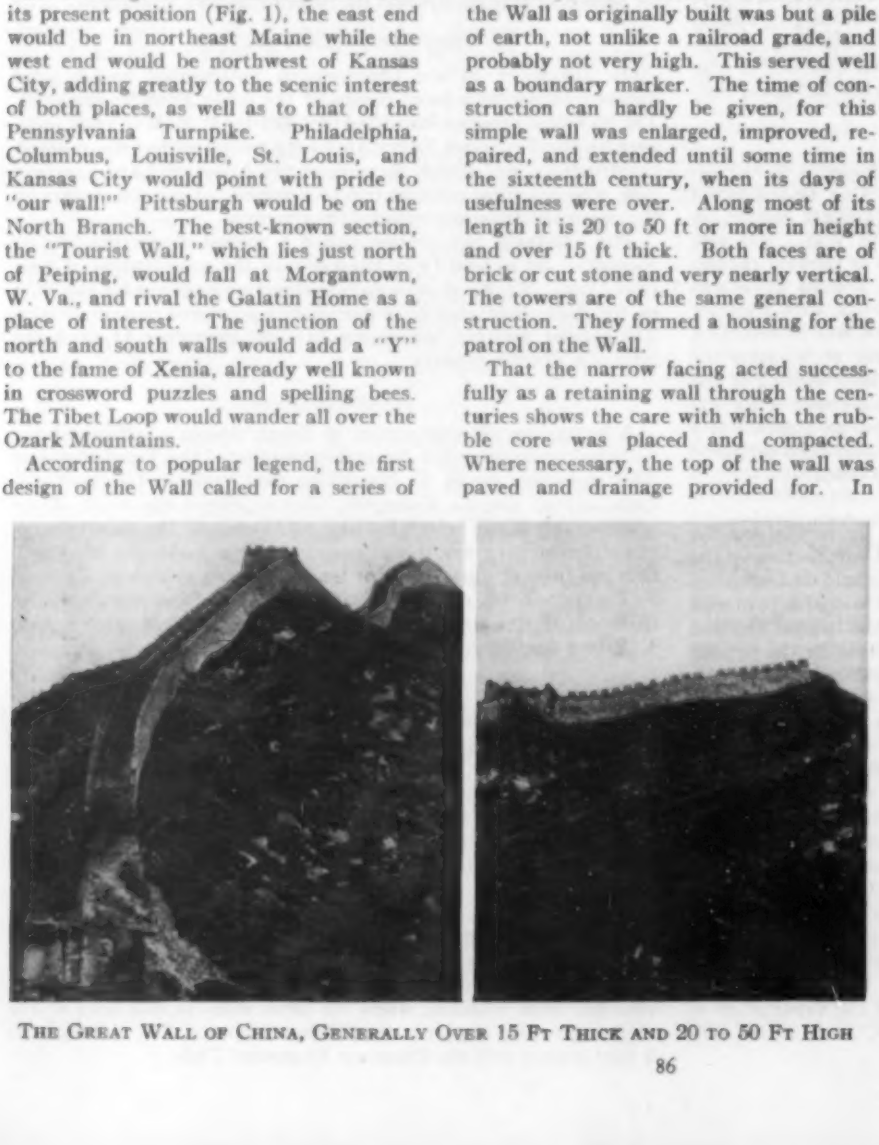
There seems to be little system to the location of the Wall. In the open country it wanders aimlessly westward, while in the mountains it wends its way along the ridges, apparently following the course of greatest resistance. Where there was a difficult place to build, there we find the Wall. Superstition and spirit lore dictated to the locating engineer in a way which is hard to understand but which was none the less real. The course follows in an indefinite way the north and west boundaries of China, or the Empire of Chin.

The engineer who had charge of the location and construction of this Wall received but a small place in history since the Emperor Chin modestly took all the credit. The engineer and his staff had their own troubles. Not only were there spirits that had to be appeased, but also "deserving politicians" who were no longer needed in the Capital and were sent to work on the Wall. At least the modern engineer is not bothered with the spirits.

The military value of the Great Wall must have been high. It turned even Attila toward Europe. The records show that China was not successfully invaded until 1211 A.D., and then it was the fault of a corrupt or weak Chinese ruler. The Mongols ingratiated themselves with the political appointees in charge of the Wall's defense, learned their habits, and when ready marched through the gates unmolested. Today a powerful fleet or army could be destroyed by the same infiltration tactics.

The idea that the Great Wall was built to promote prosperity by creating employment has often been advanced, but such a theory would be wholly inconsistent with the Chinese character. When he was a young ruler, Chin did have a group of advisers that might have been called a "brain trust," but he is best known in history by later deciding that they blocked progress and getting rid of them in a very spectacular way. As a matter of fact, a new crop of "brain trusters" promptly appeared and rewrote their predecessors' "classics" from memory before Chin was in his huge grave.

The greatest value that the Wall had was to define the northern boundary of the Chinese Empire. Those south of the Wall were Chinese, those north were Tartars. Thus the herdsmen of the north and the farmers of the south each developed a separate nationalism that helped materially in uniting China and building up the Empire of Genghis Khan. The Tartars burned themselves out by too rapid expansion while the Chinese conquered by absorption at home. The fate of those who crossed the border into China was always the same—they became Chinese or were rejected, and the Wall defined "the Border."



THE GREAT WALL OF CHINA, GENERALLY OVER 15 FT THICK AND 20 TO 50 FT HIGH

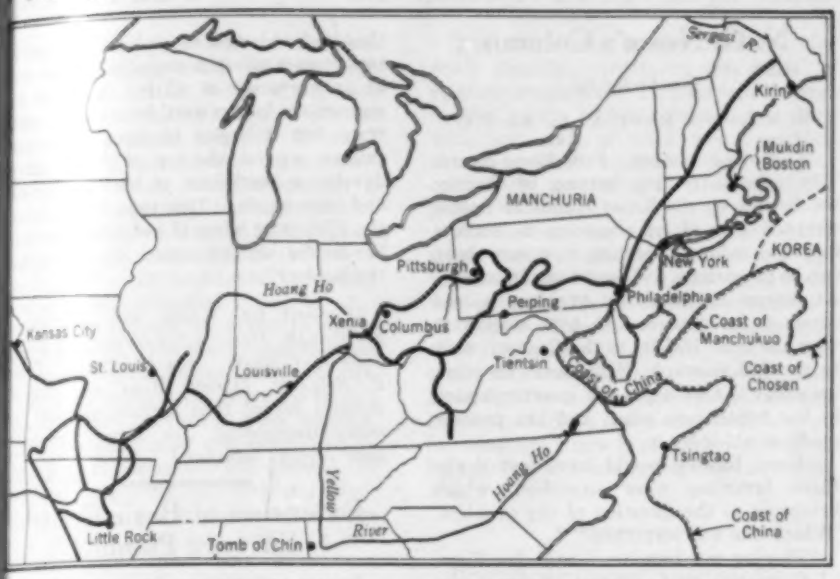


FIG. 1 GREAT WALL OF CHINA SUPERPOSED ON THE NORTHEASTERN UNITED STATES

THE WALL FOLLOWS THE RIDGES

Chin (259–209 B.C.), under whom the wall was started, should be one of the great men of history. He unified and named the Chinese Empire, he colonized Japan, he built the Great Wall. Also, he buried the "scholars" alive. After seventeen hundred years the Wall became but a tourist show and after two thousand years the Japanese got out of control (temporarily), but China is still going strong. Chin, like the Earl of Sandwich, is only remembered for one little thing—his treatment of the scholars. He, his engineers, and the Great Wall have suffered from a lack of publicity. Even his grave, which is a monument 120 ft high and 350 yd square at the base (larger than any of the pyramids), is known only locally.

As to the engineer who built the wall, his fame eclipses that of his Emperor, for every Chinese student learns his name in the first year. It was he who invented the pen (brush) and so made literature available to every one in the Empire.

Half of U.S. Workers to Be Displaced at War's End

AT THE annual meeting of the associated Equipment Distributors in Chicago, Maj. Gen. Philip B. Fleming, Administrator of the Federal Works Agency, stressed the need for coordination of post-war plans by the federal government. A condensation of his address follows:

"There is a most serious problem which millions of discharged soldiers and sailors, and many more millions of displaced war workers, will present if they are all thrown upon the labor market at one time with no jobs in sight. The size of the problem can be appreciated when it becomes evident that these people, together with their families, probably represent half of the population of the United States. Here is a potential economic, social, and political crisis of such dimensions as we never before have had to face in peacetime.

"While construction activities alone cannot be expected to provide all the jobs necessary, they can provide millions of them, both directly and indirectly, if adequate plans are made in time. It is unreasonable to hope that private business will draw up its construction plans until it can see what its needs are going to be, and that may not be until long after the war. On the other hand, cities, counties, and other units of government can plan now. They know their needs. Yet very few government units are preparing plans. Therefore, the federal government should encourage them to do so by bearing some part of the cost of plan-preparation on a loan or grant basis, and also the federal government should coordinate all the separate project plans into a unified national program which can be used in such a way as best to supplement the reconversion efforts of private business and assist the whole economy.

"Mr. Eric A. Johnston, President of the Chamber of Commerce of the United States, wants Congress to 'look to the construction industry to eliminate its own peaks and valleys as far as possible and in that way to make its contribution to providing useful employment . . . .'

"This proposal is a most interesting one, and we might consider for a moment just how it might work as a practical matter. Let's suppose that Mr. Jones, of Jones, Jones & Jones, building contractors, strolls down to his office some fine spring morning when the sun is shining and the birds singing merrily, and he says to himself, 'This would certainly be a fine day to go out and build something.' Jones needs the business. Things haven't been going so well lately. He has had to lay off most of the help and has even been reduced to the necessity of typing his own letters.

"The telephone is ringing as Jones enters the office, and he hurries to answer it.

" 'This is John Gimmick of the Gimmick Gadget Works speaking,' says the voice on the phone. 'We've got a million-dollar job for you. We want you to build a new addition to the factory and we want you to start at once, if not sooner.'

" 'Just a minute,' says Jones, 'until I look at today's chart.' He looks at the chart, and then he says, 'I'm mighty sorry, Mr. Gimmick. I'd sure like that job, but I can't take it. The graph shows the national construction volume getting dangerously close to the peak.'

"Gimmick wants to know, 'What graph, what chart, what peak?'

"So Jones explains, 'In the construction industry we are leveling off the peaks and filling in the valleys.'

"But Mr. Gimmick isn't impressed. He wants his factory addition now, and he tells Jones where he and his charts and graphs and peaks and valleys can go. Next he calls up Smith, Smith, and Smith, the rival contracting firm down the street. And I suppose Smith, Smith & Smith also are playing the peak-and-valley game, and they refuse the job, too. Or do they?

"Now, observe that Mr. Johnston expects the construction industry to eliminate the peaks and valleys all by itself. Just how is it to be done? Perhaps all the thousands of big and little contractors are going to get together in a big hotel ballroom, and sign a solemn agreement pledging themselves to a program of peak-shaving and valley-filling. In other words, they would form a combination in restraint of trade. How otherwise could you get concerted action in behalf of uniform controls? And if you do that, what becomes of the competitive system, of which Mr. Johnston is one of our foremost defenders—otherwise known as the Free Enterprise System, or sometimes, the American Way of Life?

"Now, what I propose and what millions of others—including businessmen, legislators, economists, and labor leaders—have proposed, is simply that the federal government assume responsibility for the consequences of its own policies. I want business to prepare, I want labor to prepare, most of all I want government to prepare, since it is the only over-all agency capable of unifying any truly national program.

"One might suppose that there is something alien and un-American in using the federal power to save the country—including business itself. The fact is the government has been doing it from the very start. It has never hesitated to assist business. It has protected it from competition with prohibitive tariffs. The Reconstruction Finance Corporation has loaned billions to bolster up the sagging economy. The government has dredged harbors and rivers and built port facilities at public expense to assist business. It has subsidized publishers with low postal rates, and provided the aviation industry with airports at public expense. When transcontinental railroads were needed to open up the West and private capital hesitated to assume the risks, it came to the rescue to the tune of a free gift of 20 sections of land and a credit of from $16,000 to $48,000 for every mile of track laid. Under the Homestead Act of 1862, fifty million fertile acres of the public domain were given away in twenty years to all comers, with the Civil War veterans given first choice. Agriculture has been a subsidized industry. It is only when it is proposed to use the public resources directly to create jobs for the unemployed, and indirectly to assist business itself, that federal aid is considered in some quarters to be 'tainted money.'

"We hope that private industry will very soon be able to provide jobs for demobilized service men. But we aren't staking everything on that hope. A vast amount of public work needs doing. We need schools and hospitals, water systems, and sewage disposal works. We need streets and highways, new airfields, more flight strips, more flood control works, measures to end stream pollution; we need to tear down the ramshackle tenements and replace them with homes fit for heroes to live in. All these things and more need doing. Every town, city, county, and state in the country must have its program. They have the sites to acquire, the legal work to be done, the plans for financing to be prepared. The blueprints must be ready and the contract documents drawn up."

Death of Charles Evan Fowler

NOTICE has been received of the recent death of Charles Evan Fowler in Seattle, Wash. Mr. Fowler was known to many civil engineers in the West as well as in the East.

At the time of his death he was not a member of the Society, although he had been quite active in its affairs in former years. In 1928 he established the Phebe Hobson Fowler Awards, which were bestowed for only a short period. They then became inoperative because the assets behind them, securities of a bridge project, proved valueless; the reason was that this bridge development, on which Mr. Fowler had staked so much, did not turn out to be a financial success.

His first connection with the Society was in 1890 as a Junior. He resigned in 1941.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

"I HOPE," began Professor Neare, "that the sure-thing betting of Barney the Bookie on the Xmas Handicap hasn't tempted any of us engineers to such a lucrative calling. Betting on a sure thing can be precarious, as I found out in college. At dinner on Saturday evening, it was common for someone to toss a quarter with the call, 'Heads, to the Casino; tails to the Old Howard; if it stands on edge, we study'! One night the quarter landed in the butter—on edge, and the proctor made us abide by it.

"Even Barney would have lost if the three favorites were scratched, which brings us to the question of the problem, 'Which one was scratched?' "

"Playing my hunches," said Joe Kerr, "I'd wager that Funny Fanny was scratched. Four-footed Funny Fanny was a 4-F horse just itching to go, but she didn't."

"Joe's hunch is good," declared Cal Klater, "but a little clocking with a slipstick makes the wager a sure thing. If L is the least common multiple of the digits 1 to 11, Barney's safe net on his first book would have been,

$$W = L\left(-2 + \sum_{k=1}^{11} \frac{1}{k}\right) = 28{,}271$$

"If Funny Fanny is scratched, the safe net can be figured the same way, omitting 7 in the k-series and in L, giving $W = 3{,}473$. Of course, Barney can lay in integral multiples; nine times 3,473 is 31,257 and just 2,986 greater than 28,271, as required, viz.:

HORSE	ODDS	BOOK 1	BOOK 2
After All	even	$13,860	$17,820
Black Beauty	2:1	9,240	11,880
Corny Cob	3:1	6,930	8,910
Dot Dash	4:1	5,544	7,128
Evil Eye	5:1	4,620	5,940
Funny Fanny	6:1	3,960	0
Galloping Gal	7:1	3,465	4,455
Ho Hum	8:1	3,080	3,960
Isabella I	9:1	2,772	3,564
Jo Jo	10:1	2,520	3,240
Receipts		$55,991	$66,897
Pay-off		−27,720	−35,640
Take		$28,271	$31,257

"I tried the same for the others and proved that no other horse could have been scratched."

"You're right, Cal, but you haven't proved it thoroly. Did it occur to you that the first book could have been laid in multiples just as you laid the second?"

"Never gave it a thot, Professor."

"Then it's worth a word or two. Theoretically, any horse might have been scratched, but the solutions are beyond Barney's probable means. He would have handled $84,245,991 if Jo Jo was scratched, $1,381,831,335 if it had been Isabella. These are minimum solutions of an infinite number.

"Now for a slippery-ladder problem. The ladder, weighing 16 lb and divided by rungs into 25 equal parts, is placed so that its foot is on a rough level floor and its top rests against a smooth vertical wall at an elevation of 25 ft. A 200-lb lad mounts the ladder until he is on the ninth rung, but it begins to slip. So he puts rubber caps at the top of the ladder to develop a coefficient of friction of unity and tries again. This time he get up to the 17th rung when (I bet you guessed it) the ladder slipped again. How long was the ladder?"

[*Earliest Cal Klater was Matthew J. Rorabaugh from horse-racing Kentucky. Only four others, Max W. Strauss, Jesse R. Bole, H. Herbert Howe, and Coy W. Borders proved their correct solutions, but many anonymous Joe Kerrs forwarded their obvious hunches.*]

Extension of Basic Control Surveys Planned

IN AN EFFORT to obtain data on the need for the extension of basic control surveys after the war, the U.S. Coast and Geodetic Survey has circulated the following letter to city engineers throughout the United States. Those interested should correspond with Rear Admiral L. O. Colbert, Director, U.S. Coast and Geodetic Survey, Washington 25, D.C., whose signature the letter carries.

"During recent months much attention has been given through press and radio to the very serious problems that our citizens will face following the war. One of the most certain problems will be that of reemployment of large numbers of our men returning from the armed forces. It is probable that federal, state, and private agencies will be called upon to assist in these matters, and with that possibility in mind, the Coast and Geodetic Survey is considering projects coming within its jurisdiction which may be desirable as a part of such a national program.

"One of the functions of the Coast and Geodetic Survey is the extension of triangulation and leveling in the United States to furnish basic control for mapping and engineering for city planning, flood control, reclamation, and many other public works projects. Data resulting from the work of the Bureau in establishing primary control stations are available in both spherical and plane coordinates and can be used as found to the best advantage of any particular project. Where the local engineer uses cadastral surveying methods of computing, he probably prefers the plane coordinate data. If the data are to be used in connection with city planning of large scale with extensive outlying districts, it is possible that spherical coordinates would be desirable.

"The activities of this Bureau in this line of work do not include the execution of detailed surveys in city or other project areas, but rather the establishment of the basic stations suitably distributed and in close enough proximity to such areas so that municipal or other engineers may connect thereto any local surveys on which they may be engaged. The coordination thus effected between the federal control net and local survey projects has many advantages.

"There are many extensive areas in this country, including many of our large, and numerous smaller, cities where basic geodetic control surveys do not exist at all or are extremely meager. It is believed that the extension of basic control surveys into these areas would be of great benefit providing that engineers engaged in local surveys would utilize opportunities to tie in their work to the federal control net to a sufficient extent to warrant the cost of such extension.

"For these reasons we desire to collect data bearing on these matters for such use as future developments may require. In case your department has need for additional control surveys in your vicinity, I shall be glad of your cooperation in informing me of the nature and scope of the work required, recommendations regarding the number and distribution of additional stations, and data regarding any control surveys which may have been executed in your locality by agencies other than those of the federal government."

New Plant in Brazil to Build Airplane Engines

IN THE SUMMER of 1942 it was a boggy swampland crawling with crocodiles. Today it is Brazil's fastest-growing, most modern factory, which will soon augment the United Nations' supply of aircraft engines. According to a release from the Coordinator of Inter-American Affairs, Washington, D.C., when it gets into production early in 1944, the National Motor Factory (Fabrica Nacional de Motores) will be the first plant in Latin America to build airplane engines from start to finish. That, in brief, is the story of the National Motor Factory nestled in the foothills of the steep Serra do Mar Mountains near Rio de Janeiro. Behind that story is a remarkable record of engineering skill and of closest economic cooperation between Brazil and the United States.

Fully air-conditioned, fluorescent-lighted, windowless, and "blacked-out" for security reasons, the $9,000,000 factory is as modern as the streamlined motor scooters which will speed personnel up and down its long floors. Its equipment—95% of which is already at the factory—is all-American, of the very latest type. And the plant design and the methods to be employed within the plant closely follow the U.S. model.

July 1942 marked the beginning of everything. Engineers moved onto the land and began to drain off the malaria-breeding still water. Drainage canals were built, and as soon as the land was sufficiently dry, piling for the building foundations was driven. Many good-sized crocodiles had been seen sloshing through the marshy land, and snakes and slinking jaguars also had been in evidence. But the big danger was mosquitoes. With the help of medical men and engineers who laid out the excellent drainage canals, however, the malaria rate was chopped down from 60% in 1942 to a flat zero. First-rate health conditions now prevail at the factory.

The 700-ft-long factory building, like other Brazilian structures, was made of reinforced concrete. To maintain thermal control in the building, the roof is lined with soft natural sand from northern Brazil, and it is estimated that this procedure will save 10% in air-conditioning power.

For the company's workmen and executives, factory officials are building up-to-the-minute homes and apartment houses to care for an eventual community of 25,000. This community will include the 6,000 workers in all the projected factories and their families. A modern hospital for the motor factory has already been constructed, and a cooperative store for workmen is now in operation, providing foodstuffs and household articles at lowest cost.

Forthcoming Examination for Sanitary Engineers

AN EXAMINATION for appointment as assistant sanitary engineer and passed assistant sanitary engineer in the Regular Commissioned Corps of the U.S. Public Health Service has been announced. The oral professional, academic, and physical examinations will be held in the following places: Washington, February 9 and April 4; Chicago, February 17; San Francisco, February 28; Denver, March 6; Kirkwood (Mo.), March 9; New Orleans, March 22; and Atlanta, March 25. The final written portion of the examination will be given simultaneously in all these cities beginning on April 10, and may be given at certain other stations of the Service if request is made.

Candidates for assistant sanitary engineer must be between 23 and 32, and have at least seven years of educational (exclusive of high school) and professional training, or equivalent experience. Candidates for passed assistant sanitary engineer must not have passed their thirty-ninth birthday on the date of examination and, in addition to the qualifications for assistant sanitary engineer, must have had two years of postgraduate instruction, research, or teaching in some specialized branch of sanitary engineering, and at least two years' practice in their specialty.

Compensation, including allowance for quarters and subsistence, is $3,411 for assistant with dependents, and $2,975.50 for assistant without dependents; and $3,991 for passed assistant with dependents, and $3,555.50 for passed assistant without dependents. Applicants should address the Surgeon General, U.S. Public Health Service, Washington, D.C., in their own handwriting, requesting permission to appear before the board of examiners.

Brief Notes

A SYMPOSIUM on the application and uses of synthetic rubber will be the technical feature of the spring meeting of the American Society for Testing Materials, which will be held in Cincinnati—at the Netherland Plaza—from February 28 to March 3.

* * * * *

THE City Planning Division of the Massachusetts Institute of Technology is sponsoring a short training course in city and regional planning during the spring of 1944. This course, which will be open to men and women with professional experience in architecture, landscape architecture, civil engineering, political science, or public administration, will commence on April 3 and continue for twelve weeks. Further information may be obtained from Prof. Frederick J. Adams, Division of City Planning, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.

NEWS OF ENGINEERS

Personal Items About Society Members

BREHON B. SOMERVELL and ARTHUR A. JOHNSON are this year's recipients of The Moles Awards "for outstanding contributions to construction progress." General Somervell is an Honorary Member of the Society, and commanding general of the Service of Supply of the U.S. Army. He was selected for the award "in recognition of his brilliant administration of the Army Service Forces." Mr. Johnson is president of the Arthur A. Johnson Corporation, and for more than thirty-five years has been engaged in the building of subways, tunnels, and other engineering works in and around New York. Presentation of the awards will be made at the annual dinner of The Moles, which will be held in New York on February 2.

WILLIAM W. AULTMAN has been promoted from the rank of lieutenant in the Civil Engineering Corps of the U.S. Naval Reserve to that of lieutenant commander. He is now executive officer of the Eighth Naval Construction Battalion.

ROBERT F. BLANKS and JACOB E. WARNOCK are two of six members of the staff of the U.S. Bureau of Reclamation, to whom Awards of Excellence have been made "for ingenuity, efficiency, and inventive talents displayed in the Government service." Both recipients are senior engineers in the materials, testing, and control section of the Bureau.

FRED LAVIS, consulting engineer of New York, has gone to Caracas, Venezuela, at the request of the Minister of Public Works of that country to advise on the operating problems of the Gran Ferrocarril of Venezuela—a 184-km line between Caracas and Valencia. It is expected that this line will be combined with others to form a through system from La Guaira to Barquisimeto in the state of Lara.

REEVES J. NEWSOM, New York engineer, has been appointed village manager of Scarsdale, N.Y., succeeding the late ARTHUR BONIFACE. Mr. Newsom, who was for ten years an engineer for the

city of Lynn, Mass., will take office at the start of the fiscal year on March 1.

AUGUST HANS WAGENER was recently appointed commissioner of public works for Rochester, N.Y. Until recently he was director of planning in the Rochester Department of Commerce.

WILLIAM A. ZOBEL, commander, Civil Engineering Corps, U.S. Naval Reserve, is now resident officer in charge of contracts NOy-3570 and NOy-6060 for Alaskan bases at Seattle, Wash. He is in the office of the Navy's contractor, Siems Drake Puget Sound.

HARVEY L. VINCENT, for the past two years with the Lummus Company in Little Rock, Ark., and Huntington, W.Va., has enlisted in the Construction Battalions of the U.S. Navy and is training in the Chief Petty Officers' School at Camp Peary, Va.

WARREN W. PARKS has resigned as chief engineer of Mariemont, Ohio, in order to become manager of Indian Hill, also a suburb of Cincinnati.

L. STERLING HEDGPETH, for the past three years a civil engineer for the U.S. Engineer Office on the design and construction of airports in Puerto Rico and Brazil, recently accepted a transfer as highway engineer in the design division of the Public Roads Administration in Washington, D.C.

JOHN F PARTRIDGE has severed his connection as construction engineer for the Tennessee Valley Authority on Fort Loudon Dam in order to accept a commission as major in the U.S. Army. He has been assigned to the military government work in occupied territories.

FREDERICK S. MERRITT, formerly structural designer for Gibbs and Hill, of New York, N.Y., is now field service engineer for D. W. Haering and Company, of New York, for whom he is specializing in the prevention of corrosion and scale formations.

ALF A. LEWIS, after a year and a half as structural engineer for Blaw-Knox on the development of their synthetic rubber program, is now in the engineering department of the Guiberson Corporation in Dallas, Tex.

FRANCIS BLOSSOM and RALPH BUDD have been honored by recent election as honorary members of the American Society of Mechanical Engineers. Certificates were conferred at the December 1943 annual meeting of that society. Colonel Budd is president of the Burlington Railroad, while Mr. Blossom is a partner in the New York consulting firm of Sanderson and Porter.

JOHN L. SAVAGE, chief designing engineer for the U.S. Bureau of Reclamation at Denver, Colo., has left on a special Far Eastern mission. His plans for the trip tentatively include a four-month stay in India, where he will work on the design of a large irrigation dam, and a six-month stay in China, where he will work on the design of three projected dams.

WILLIAM T. INGRAM, assistant regional sanitary engineer for Region IX of the U. S. Public Health Service, with headquarters in San Francisco, has been promoted to the position of regional sanitary engineer. He succeeds MAJ. GERALD E. ARNOLD, who has been assigned to the San Francisco district of the War Production Board. Mr. Ingram's position will be filled by JOHN C. LUTHIN, until lately office engineer at the Richmond (Calif.) shipyards of the Kaiser Company.

STANTON WALKER, director of engineering for the National Sand and Gravel Association, Washington, D.C., was elected chairman of the Highway Research Board at the annual meeting of the organization, which was held in Chicago, November 27 to 30.

JAMES S. WATKINS has been appointed state highway commissioner of Kentucky by Governor Simeon S. Willis. Mr. Watkins, who has maintained an extensive consulting practice at Lexington, Ky., since 1933, was executive project manager in charge of the design and construction of Camp Campbell, said to be one of the largest cantonment projects ever constructed by the War Department.

JOSEPH GARDNER BENNETT, for the past three years an instructor in civil engineering at Robert College, Istanbul, Turkey, recently accepted an appointment as associate professor of civil engineering at the University of Wyoming.

FRANCIS P. WITMER, who retired recently as professor of civil engineering at the University of Pennsylvania, was honored by the engineering alumni of the university on December 3, when the group presented him a scroll in recognition of his many years of "loyal and distinguished service."

HENRY G. PERRING, a member of the Baltimore consulting firm of Perring and Remington, has been appointed harbor engineer, and as such is head of the Bureau of Harbors of the Baltimore Department of Public Works.

EUGENE E. HALMOS has completed a three-year assignment as engineer of design review with Drydock Engineers, and has returned to his regular association with Parsons, Brinckerhoff, Hogan and Macdonald, New York City consultants.

DECEASED

JULIUS MONTGOMERY BISCHOFF (Assoc. M. '10) office engineer for the Terminal Railroad Association of St. Louis, Mo., died on December 5, 1943. He was 62. Mr. Bischoff had been with the St. Louis Terminal Railroad Association since 1914—successively as principal assistant engineer, assistant engineer and, since 1920, as office engineer. Earlier he had been with other railroads in this country, and from 1911 to 1914 was resident engineer for the Cuban Central Railways at Santa Clara, Cuba.

JOSHUA PRICE CHURCH (M. '36) district highway engineer in the New Mexico State Highway Department at Roswell, N.Mex., died in April 1943. Mr. Church, who was 48, had been with the New Mexico State Highway Department since 193[illegible]. Earlier (1923 to 1932) he was construction engineer for the Martin Engineering Company on various projects, including the construction of oil refineries and appurtenant structures in Venezuela.

JAMES COWIN (M. '20) president of Cowin and Company, of Minneapolis, Minn., died in that city on December 1[illegible], 1943. Mr. Cowin, who was 59, was for many years president of Cowin and Company, manufacturers of steel products, with offices in Minneapolis and Winnipeg. He was also president of the Steel Service Company, of San Francisco, and of the Indian Bolt and Nut Company, of Minneapolis.

LEONARD MARTIN COX (M. '04) captain, Civil Engineering Corps, U.S. Navy (retired), St. Helena, Calif., died at his home there on December 12, 1943. His age was 73. A specialist in maritime engineering, Captain Cox had been in the service of the Navy since 1899, when he was commissioned lieutenant (jg) in the Civil Engineering Corps. He had been public works officer at Norfolk (Va.), New York, San Francisco, and Mare Island (Calif.). Captain Cox spent 1912 and 1913 in Alaska as a member of the first Alaska Railroad Commission, and during the first World War was assistant manager of the Shipyard Plants Division of the Emergency Fleet Corporation. Commissioned a captain in 1921, he retired from active duty several years ago.

EDOUARD JEAN BERNARD DE MEY (M. '21) vice-president of Edward Crump, Jr., Inc., Pittsburgh, Pa., died on November 20, 1943, at the age of 54. Beginning in 1915, Mr. de Mey was for some years construction engineer for Toupet Beil and Conley, Inc. Later he maintained a consulting practice in Pittsburgh and, for a time, was a member of the firm of Conley and de Mey.

THOMAS LINUS KEITH DONNELLY (M. '27) consulting engineer of Bay City, Mich., died on December 20, 1943, at the age of 61. Mr. Donnelly's early career was spent in railroad work. Later he was engaged in public-utility appraisal work and in railroad valuation in connection with Interstate Commerce Commission hearings. He was with the S. S. Kresge Company from 1929 to 1932, and district maintenance engineer for the Michigan State Highway Department from 1934 to 1938. In the latter year he established his engineering practice. During the first World War Mr. Donnelly served overseas with the 48th Engineers, having the rank of captain.

HARRY CLYDE DOVERSPIKE (Assoc. M. '34) associate engineer for the U.S. Engineer Office at Cincinnati, Ohio, died on December 6, 1943. Mr. Doverspike, who was 45, had spent practically his entire career with the U.S. Engineer Office, having been stationed at Pittsburgh, Pa., for most of this period. He had also been in the St. Paul District, where he prepared specifications for Mississippi River locks.

EDWIN STANTON FICKES (M. '04) who retired six years ago as senior vice-president of the Aluminum Company of America, died in Pasadena, Calif., where he had

gone to spend the winter, on December 19, 1943. His age was 71. Mr. Fickes became connected with the Aluminum Company of America in 1899. The next year he was made chief engineer of the company, with headquarters at the New Kensington works. Soon after, he took over the design of all building, engineering, and repair work. In 1919 he was promoted to vice-presidency, and in 1931 was named senior vice-president.

JAMES MADISON GARRETT (M. '17) a pioneer highway engineer in the South and former city engineer of Montgomery, Ala., died at his home there on December 20, 1943, at the age of 79. From 1890 to 1900 Mr. Garrett was county engineer for Alabama County, and from 1900 to 1916 was engaged in private business. Later (1924 to 1940) he served as city engineer of Montgomery. By profession he was a railroad locating engineer and helped to lay parts of the Atlantic Coast Line road.

CHARLES WESCOTT GENNET, JR. (M. '23) vice-president of the Sperry Rail Service Corporation, of Chicago, Ill., died on October 26, 1943, at the age of 67. From 1899 to 1907 Mr. Gennet was with the Southern Railway, and from 1908 to 1928 was in charge of inspecting and testing steel rails for the Robert W. Hunt Company, of Chicago. Since 1928 he had been vice-president of the Sperry Rail Service, testing rails in track.

WELLINGTON BARNES LEE (M. '98) retired engineer of New York, N.Y., died on May 3, 1943, though the Society has just heard of his death. His age was 76. From 1890 to 1902 Mr. Lee was chief draftsman for the Ramapo Iron Works, and from the latter year to 1914 sales engineer for the same organization. He then became president of the Track Specialties Company, remaining in that connection until his retirement about a year ago.

LEON ELIE LYON (M. '06) colonel, Corps of Engineers, U.S. Army (retired), died suddenly at his home in New Orleans, La., on December 9, 1943. Colonel Lyon had been in the Corps of Engineers practically his entire career. He had been district engineer at Philadelphia, Pa., and Montgomery, Ala., and corps area engineer at Atlanta. He retired from the Army in 1937, but was called to active duty in 1940, retiring again in October 1943.

THOMAS ALBERT MCTEER (Jun. '42) first lieutenant, Corps of Engineers, U.S. Army, was killed in North Africa on June 25, 1943. He was 22. After receiving the degree of B.C.E. from Clemson College in 1942, Lieutenant McTeer enlisted in the Corps of Engineers.

FRANK COOK MOORE (M. '18) of Richmond Hill, N.Y., died on May 14, 1943, at the age of 72. From 1894 to 1901 Mr. Moore was with the Boston Bridge Works, and from 1901 to 1936 was with the American Bridge Company in New York—in charge of the design and estimate of structural steel work for structures in this country and abroad. He retired in 1930. Mr. Moore's specialty was the development of standards for speed and convenience in designing structural steelwork.

JAMES THOMAS PARDEE (M. '01) emeritus chairman of the Board of the Dow Chemical Company, Midland, Mich., died at his home there on January 3, 1944. Mr. Pardee, who was 76, had been chairman of the Board of the Dow Company for more than forty-five years. He was noted as a builder of bridges and, at one time, was in charge of that work for the city of Cleveland.

CHARLES JEREMIAH PARKER (M. '00) retired engineer of Bronxville, N.Y., died recently at Elmira, N.Y. Mr. Parker had been a resident of Bronxville for thirty-three years, and for thirty-nine years was connected with the New York Central. At the time of his retirement eight years ago, he was superintendent of insurance.

HOWARD CRATHONE PHILLIPS (M. '13) retired engineer of Chicago, Ill., died on November 14, 1943, at the age of 74. Beginning in 1898, Mr. Phillips was for many years connected with the Atchison, Topeka and Santa Fe Railway system. Later he was assistant general secretary for the President's Conference Committee on Federal Valuation of Railroads, in both Philadelphia and Chicago, and for some years maintained a consulting valuation practice in Chicago. He retired in 1941.

WALTER ALEXANDER ROGERS (M. '00) founder and chairman of the Board of the Bates and Rogers Construction Corporation, Chicago, Ill., died at the Mayo Clinic at Rochester, Minn., on January 3, 1944. In a few days he would have been 76. For the first thirteen years of his career Mr. Rogers was in railway engineering work, resigning in 1901 to organize his construction firm in partnership with the late Onward Bates, one-time President of the Society. In 1938 he retired as president of Bates and Rogers, but as chairman remained active in company affairs up to the time of his death.

GEORGE PHILIP ALEXANDER STAPE (Assoc. M. '19) who was in the engineering department of the Eastman Kodak Company, at Rochester, N.Y., died on December 3, 1943. Mr. Stape's early work was in the automobile and airplane field, and at one time he was an engineer with the Dayton Wright Aeroplane Company at Dayton, Ohio. Coming to Rochester in 1923, he had been employed since then by the Eastman Kodak Company.

HARRY EDWARD TYRRELL (M. '23) chief engineer, maintenance of way and structures for the Southern Railway Company at Knoxville, Tenn., died on December 5, 1943. Mr. Tyrrell, who was 61, had been with the Southern Railway in varying capacities since 1912, and as chief engineer on maintenance of way and structures since 1934. His earlier experience had also been in railroad work and with the American Bridge Company.

GEORGE GROVER WICKLINE (M. '20) bridge engineer for the Texas State Highway Department at Austin, was fatally stricken at Dallas on November 27, 1943, while en route to Chicago to attend the annual convention of the American Association of State Highway Engineers. Mr. Wickline, who was 60, had been with the State Highway Department since 1918. During this long period of service he supervised construction of most of the modern highway bridges in the state. These structures include the South's tallest bridge, which stands 230 ft above the Sabine-Neches waterway, permitting passage of ocean-going vessels.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From December 10, 1943, to January 10, 1944, Inclusive

ADDITIONS TO MEMBERSHIP

ESTEN, ROBERT ERWIN (Jun. '43), With U.S. Army; 808 Park Ave., Charlestown, W.Va.

NDERSON, WILLIAM CRAWFORD, JR. (Jun. '43), Ensign, CEC-V (S), U.S.N.R.; R.F.D. 2, Oxford, Miss.

PEL, WALTER MICHAEL, JR. (Jun. '43), Private, Air Corps, U.S. Army; 1655 Steele St., Denver, Colo.

CKSTEAD, MAURICE WEBSTER (Jun. '43), Ensign, U.S.N.R.; Box 124, Carpinteria, Calif.

KA, CHARLES PERRY (Jun. '43), Junior Engr., Curtiss-Wright Corp., Port Columbus (Res., Y.M.C.A., Room 544, Columbus), Ohio.

BENNETT, GROVER BRYCE (Jun. '43), Apprentice Engr., Pan-Am. Airways, Terminal, Box 3268 (Res., 2808 West Eaton), Seattle, Wash.

BERRY, CLAYTON ARTHUR (Jun. '43), Midshipman, U.S.N.R.; 614 Rowley North, Mitchell, S.Dak.

BICKERSTAFF, GEORGE ALLEN (Jun. '43), 2d Lt., U.S.M.C.R.; 1500 Palmyra Ave., Richmond 22, Va.

BLOOD, DAVID LIVINGSTONE (Jun. '43), Naval Archt., Puget Sound Navy Yard (Res., 1108 Audrey Ave.), Bremerton, Wash.

BOSTROM, WILLIAM HARDING (Jun. '43), 2d Lt., Field Artillery, U.S. Army; Box 571, Eaton, Colo.

BOUNDS, CARROLL JORDON (Jun. '43), Private, Air Corps, U.S. Army; 1228 Spottswood Ave., Norfolk 7, Va.

BOWEN, EMMA FRANCES (Jun. '43), Structural Engr., Stress Unit, Boeing Aircraft Co. (Res., 4712 Twenty-first Ave., N.E.), Seattle 5, Wash.

BUETTNER, CHARLES EDWARD (Assoc. M. '43), Supervisor of Design Draftsman, Union Elec. Co. of Missouri, 322 North 12th Blvd. (Res., 4137 Toenges Ave.), St. Louis 16, Mo.

BURKE, EDWARD LEON (Jun. '43), Structural Draftsman, Mech. Eng. Dept., Carnegie-Illinois Steel Corp., Duquesne Steel Works, Duquesne (Res., 213 Center St., Wilkinsburg 21), Pa.

BURTON, PHILIP ALEX (Jun. '43), Ensign, U.S.N.R.; 74 Forest Lawn Ave., Stamford, Conn.

BUSTAMANTE, JOAQUIN REDONDO (Jun. '43), Engr. (Class D), National Irrig. Comm. of Mexico, Calle Baleras 94 (Res., Calle del Havre 44), Mexico, D.F., Mexico.

CHIN, HING-YUEN (Jun. '43), Structure Engr., Lockheed Aircraft Corp. (Res., 435 Delaware Rd.), Burbank, Calif.

CLARKE, FRANK TACKETT (Assoc. M. '43), Chf. Civ. Engr., The Union Sulphur Co., Inc., Sulphur, La.

COBB, JAMES FORREST (Jun. '43), Ensign, CEC, U.S.N.R.; Lake City, Iowa.

COLLEY, ROBERT FRANCIS (Jun. '43), Ensign, U.S.N.R.; 351 South 19th St., San Jose, Calif.

COLLINS, GEORGE FRED (Assoc. M. '43), Draftsman, Bell Laboratories, Inc., 180 Varick St., New York (Res., 8409 Talbot St., Kew Gardens), N.Y.

COLLINS, ROBERT WILLIAM (Jun. '43), Ensign, CEC, U.S.N.R.; 1425 West Marquette Rd., Chicago 36, Ill.

CRULL, RALPH LEE (Jun. '43), Levelman, State Highway Dept. (Res., 83 Mitchell Drive), Phoenix, Ariz.

CURTIS, GEORGE WILLIAM (Jun. '43), Ensign, U.S.N.; 55 Pineapple St., Brooklyn 2, N.Y.

DANDROW, CHARLES GEORGE (M. '43), Dist. Mgr., Johns-Manville Sales Corp., 22 East 40th St., New York 16, N.Y.

DAVIDSON, OLE (M. '43), Engr., Roads and Railroads, Stone & Webster Eng. Corp., Boston, Mass. (Res., Arnold Hotel, Knoxville, Tenn.)

DAVIES, MARSHALL FREDERICK (Jun. '43), Junior Engr., Dravo Corp., Neville Island, Pittsburgh (Res., 225 Broad St., Sewickley), Pa.

DEGRAFF, ALBERT GEORGE (Assoc. M. '43), Res. Mgr., The Austin Co., 1802 Girard Trust Bldg., Philadelphia 2, Pa.

DEMPSEY, JOHN GODDARD (Assoc. M. '43), Associate Engr., U.S. Army, Office, Post Engr., Army Post Office 856, Care, Postmaster, New York, N.Y.

DILLARD, FRANK CARLETON (M. '43), Engr. (Toledo Logging Co.), Gleneden Beach (Res., Nelscott), Ore.

DODGE, HARLAND PRAY (M. '43), San. Engr., The Francis Eng. Co., 303–304 Eddy Bldg., Saginaw, Mich.

DURKEE, JACKSON LELAND (Jun. '43), Research Laboratory Analyst, Douglas Aircraft Co. (Res., 1008-B Sixth St.), Santa Monica, Calif.

EICHNER, DONALD WILLIAM (Jun. '43), Ensign, EV(S), U.S.N.R.; 919½ Kentucky, Vallejo, Calif.

ESTES, CHARLES CRAWLEY (M. '43), Gen. Mgr., J. S. Barrett, 1300 Coast Highway, Newport, Calif.

FALLER, WILLIAM MARCUS, 3d (Jun. '43), Stress Analyst, Otis Elevator Co., 260 Eleventh Ave., New York, N.Y. (Res., 1215 Palisade Ave., Union City, N.J.)

FARWELL, JOSEPH WILLARD, JR. (Jun. '43), Private First Class, U.S. Army; Fairhaven Rd., Mattapoisett, Mass.

FLEISCHMAN, VOLNEY GEORGE (Jun. '43), Asst. Airways Engr., Civ. Aeronautics Administration, Smith Tower Annex (Res., 1003 South West 158th St.), Seattle 66, Wash.

FRENCH, EARL RICHARD (Assoc. M. '43), 71 Concord St., Ashland, Mass.

FRENZEL, HARRY HORTON (M. '43), Naval Archt., Marine Design Branch Transportation Corp., Duttenhoffer Bldg. (Res., 3547 Rosedale Pl.), Cincinnati 29, Ohio.

GELWIX, MAX (Jun. '43), Sgt., U.S. Army; Thayer, Kans.

GESSOW, ALFRED (Jun. '43), 124 Tapscott St., Brooklyn 12, N.Y.

GILLEN, JAMES STEWART (Jun. '43), Ensign, CEC, U.S.N.R., Advanced Base Depot, Port Hueneme, Calif.

GLEASON, ROBERT JOSEPH (Assoc. M. '43), San. Engr., U.S. Public Health Service, Washington, D.C. (Res., 517 East 235th St., New York 66, N.Y.)

GLOVER, JAMES (Jun. '43), Junior Metal Insp., Humble Oil & Refining Co., Humble Dormitory, Baytown, Tex.

GORLIN, JACOB (Jun. '43), Private, Air Corps, U.S. Army; 244 East 13th St., New York 3, N.Y.

GRAESER, HENRY JACOB, JR. (Assoc. M. '43), Capt., San. Corps, U.S. Army, Station Hospital, Camp Shelby, Miss.

GREEN, CHESTER HENRY (Assoc. M. '43), Civ. Engr., Sanitation & Storm Drain Div., Los Angeles County Engrs. Office, 700 Union League Bldg., Los Angeles (Res., 4837 Grand Ave., La Canada), Calif.

GURALNICK, IRVING MILTON (Jun. '43), Stress Engr., Stress Dept., Fairchild Aircraft, Plant 2A, Hagerstown, Md.

HAPKE, DANIEL BOY (Jun. '43), Instr., Civ. Eng. Dept., Oklahoma Agri. and Mech. College, Stillwater, Okla.

HARRINGTON, JOSEPH JOHN (Assoc. M. '43), 809 Ocean Ave., Brooklyn 26, N.Y.

HEANEY, JOHN FRANCIS, JR. (Jun. '43), Ensign, U.S.N.; 31 Chase Ave., Lexington, Mass.

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TOTAL MEMBERSHIP AS OF JANUARY 10, 1944	
Members	6,014
Associate Members	7,361
Corporate Members	13,375
Honorary Members	36
Juniors	5,971
Affiliates	75
Fellows	1
Total	19,458
(January 8, 1942	18,395)